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THOROUGHLY REVISED AND MUCH ENLARGED,

BY

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ASSISTED BY

A LARGE CORPS OF THE MOST EMINENT AMERICAN SURGEONS.

IN THREE VOLUMES,

WITH MANY ILLUSTRATIONS.

VOL. III.

*DISEASES OF THE RESPIRATORY ORGANS. DISEASES OF THE BONES,
JOINTS, AND MUSCLES. DISEASES OF THE NERVOUS SYSTEM.
GUNSHOT WOUNDS. OPERATIVE AND MINOR SURGERY.
MISCELLANEOUS SUBJECTS.*

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[1] [Mr. Brodhurst's portion of this essay comprises the section on "Congenital Dis and Intra-Uterine Fractures;" Mr. Shaw's, that on "Lateral Distortion of the Spine

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[1] The remainder of this essay is by Alex. Shaw, Esq.

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PART I.

DISEASES OF THE RESPIRATORY ORGANS.

DIPHTHERIA AND CROUP.
DISEASES OF THE LARYNX.
DISEASES OF THE THYROID BODY.
APNŒA.

A SYSTEM OF SURGERY.

PART I.

DISEASES OF THE RESPIRATORY ORGANS.

DIPHTHERIA AND CROUP.

BY A. W. BARCLAY, M.D.

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DIPHTHERIA.

A FEW years ago the name of Diphtheria was unknown in England. It is highly probable that the descriptions of some of our older writers refer to this disease, which no doubt appeared then, as now, in an epidemic form; but for a very long period England had been free from its presence, and our acquaintance with its symptoms and consequences was till recently wholly derived from observations made in France, where it had been known and studied for a number of years. Prior to 1850, it must be confessed that a lingering doubt remained in the minds of many on this side the Channel, whether it did really differ from our own croup, or might not perhaps be explained merely by an unusual prevalence of croup during the existence of an epidemic of scarlatina. Careful observation seems to show that it is distinct from both these diseases, but that its relationship is in many respects so close that no better description can be given to one not conversant with the disorder than that it holds a place intermediate between them. It partakes of the febrile character and epidemic influences of the one, and of the specific exudation of the other; it combines general symptoms which belong specially to the fever, with local symptoms which belong wholly to the inflammation: and when it kills, it does so either by the general exhaustion which characterizes more or less all epidemic diseases, or by the suffocation which depends on the exudation of fibrin, exactly like that which occurs in croup.

With all this, it is a very remarkable fact that the spread of diphtheria generally coincides with the prevalence of scarlatina. Since it first made its appearance in England, the same observation has come from so many quarters that it is impossible to regard it as a mere coincidence. Indeed it has formed one of the great obstacles to our acquiring definite information regarding it, that the two diseases have so constantly run alongside of each other, and so completely merged into one another, that it has been difficult to separate them, and to distinguish between the effects produced by each. It has not unfrequently happened that in the same family, within a very short period, one member has suffered from diphtheria, and another has had an attack of scarlatina, and each has been so marked as to leave no doubt on the subject: but if the cases were not so clear, or if, as has often happened, the question of diversity were never raised at all, the two sets of symptoms would be set down to the same cause, and false inferences drawn as to the true character of the disorder.

This circumstance has no doubt given greater vagueness to the descriptions of the older writers than would otherwise have been the case, but the conclusion is unavoidable that cases occurred in their practice also, and that doubts have often arisen as to whether it was or was not a form of scarlet fever. They were not conversant, as we are, with the exudation-process, and did not discriminate between patches of lymph resting upon the surface of the mucous membrane, and a slough involving its superficial layer. They were, indeed, surprised that when the layer was detached, the membrane was found healthy beneath it; but pathology was not sufficiently advanced to draw intelligent conclusions from such observations, and we can gather little from the past that can be of use in the consideration of the special character and treatment of this disease.

History.—The first observations which, in this country at least, led to a true understanding of the nature of that false membrane which so eminently characterizes diphtheria, were made with reference to sporadic croup by Dr. Home,[1] about the middle of the last century. He first recognized the existence of a mass of fibrin, moulded to the form of the subjacent structures, and adherent to the mucous membrane, but lying quite upon its surface, "and generally lying loose upon it." Prior to this date such exudations were supposed to be part of the membrane itself, detached in the form of a slough. His descriptions, as well as those of Dr. Cheyne,[2] forty years later, prove that in the sporadic croup of their day the exudation was confined to the trachea, and did not spread to the fauces.

So truthful were these descriptions of croup, and so entirely did they correspond with the experience of British practitioners, that we were for some time disposed to doubt the correctness of our neighbors' observations; just as they imagined that there must be some error in our way of regarding croup, because it was so unlike what they were studying in the epidemic sore throat, which some years ago began to attract attention in France. Yet each set of observations was true in its own place; the two diseases were perfectly different in their origin, although they presented the curious coincidence of the exudation of false membrane, at that point where its presence interfered with one of the most important functions of life, and not unfrequently caused death by suffocation.

Bretonneau, in his Memoirs[3] read before the French Academy in 1821, was the first to give a scientific account of the epidemic disease; and its symptoms have undergone so little change, that his report continues to be a very faithful picture of the usual forms which it presents, although his theory of the local character of the disease has been now almost entirely abandoned. Till very recently this view was maintained by many of the best French pathologists; and Trousseau has perhaps been the last to yield the point, that the empoisonment of the blood, as exhibited in the general symptoms, was not merely a consequence of the local affection, and of the absorption of some material connected with the exudation. This question, though in itself one of mere abstract reasoning, which could be put to no precise test of its truthfulness, yet reached far beyond the battlefield of opposing theorists; for it offered a satisfactory reason for endeavoring promptly and effectually to remove the exudation by local applications, while it led to the overlooking of such measures as were calculated to counteract a blood-disease, which it was assumed could be prevented or cured only by the removal of the local affection. The practice thus introduced has continued more or less to form the basis of very many of the modes of treatment, and with too many the aim has only been to discover the most efficient local remedies, instead of seeking to overcome the general disorder of which we now believe the exudation to be only a part.

Symptoms.—The main symptom on which reliance is placed in the diagnosis of diphtheria, is the presence of false membrane. Like many other diseases with which we are only imperfectly acquainted, one prominent symptom, the first indeed which led to the recognition of its separate and distinctive character, has almost usurped the place in nosology which belongs to the blood-poison which gives it birth. But the more we are compelled in our ignorance to rely on one pathognomonic sign, the more surely are we exposed to the risk of error in the conclusions at which we arrive. The characters of the sign may seem to be very definite when a well-marked example is presented to us; but if it be at all obscure, we are forced to look for other indications to aid our judgment. In the investigation of diphtheria we are met on the threshold with a very prominent fact, which gives it a place at once in our nosology as a blood-poison; for so we must at present call it, while confessing our ignorance of what blood-poisoning means. It comes to us under the form of an epidemic; it attacks one individual after another; it breaks out in a given locality; singles out a certain proportion of the community for its victims; and then disappears. We ask how it came, and how it went; and the answer must be necessarily somewhat vague. Sad experience has proved that persons who have been accidentally inoculated, so to speak, with the exudation, have caught the infection and suffered from the disease. And as with other inoculable diseases, which are also certainly conveyed from the sick to the healthy through the atmosphere without actual contact, so with this there seems every reason to believe that in certain investigated instances the infection has been so propagated; and we can hardly withhold our assent to the proposition that it may be so in all, although it is not always, perhaps not often, possible to trace the source of the infection, and the means of its transmission. It matters not, however, whether the theory of the contagionists or of the non-contagionists be proved the true one; the fact still remains, that diphtheria has all the known characters of an epidemic. It is not meant to assert that no isolated case can be diphtheria, but all such must ever be received with suspicion; and if the case be really isolated, it will probably be found wanting in some of the distinctive characteristics of the disease, and may possibly be referred to some other form of throat affection.

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[1] An Inquiry into the Nature, Causes, and Cure of the Croup, by Francis Home, M.D.

[2] Essays on Diseases of Children, by John Cheyne, M.D.

[3] See Memoirs on Diphtheria, published by the New Sydenham Society.

But while it is admitted that the epidemic character is essential to the existence of diphtheria, it is somewhat difficult in the presence of an epidemic to discriminate cases which might have occurred as simple sore throat in its absence. The mucous membrane is perhaps only redder than usual; it may have a slight glazy exudation, or even that may be wanting. And the chief peculiarity consists in the cases being very numerous, and there being no tendency to suppuration or ulceration, as the result of the inflammatory action. Such affections of the membrane of the throat always accompany the spread of the genuine diphtheritic inflammation; and our definition must be made wide enough to embrace them, because although the chief pathognomonic sign be wanting, yet they are, without doubt, part of the epidemic, and quite as essential to a right understanding of the disease as the more marked forms to which the name is more truly applicable.

Definition.—Diphtheria may, then, be characterized as a blood-poison propagated by transmission through the atmosphere in the majority of instances, either as a miasm from the bodies of the sick, or in consequence of some atmospheric changes as yet unknown to us. This poison, after the lapse of a very few days from the date of exposure to infection, produces a general febrile action throughout the body, and a distinct local inflammation limited to the membrane covering the throat. Quite exceptionally, deep-seated abscess may form in consequence of it; but most commonly there is only simple inflammation of the glands of the neck, which are tense and tender: these accidents, however, are not essential to the disease in the same sense as the specific action on the mucous membrane.

Albuminuria.—In addition to this, an albuminous state of urine is very common in the severer forms of diphtheria. As in scarlatina, the presence of albumen is simply due to congestion of the kidney; and we conclude that in some way or other the vitiated or poisoned blood stimulates the capillary vessels so as to produce this state of congestion; but we have as yet no clue to unravel further the mystery. In the one disease the urine presents no trace of albumen during the acute stage, the congestion only appearing with the desquamation of the cuticle after the febrile condition—the scarlet fever, so to speak—has passed off; in the other it commences at a very early period of the disease, generally lasts only for a few days, and does not cling to the patient during convalescence, as is the case so often in scarlatina. It causes no surprise that we cannot explain these peculiarities, since we have no idea why the complication exists at all, when it does not accompany any other form of sore throat, nor to the same extent any other febrile disorder.

Paralysis. — Another phenomenon accompanies or rather follows upon attacks of diphtheria with sufficient frequency to establish a certain relationship between them; but as yet we can only affirm that paralytic affections may be apprehended after partial convalescence from diphtheria—after, indeed, the throat has got perfectly well, and nothing seems wanting to recovery but the due performance of the nutritive functions. This must be the gravest of the sequelæ, if it be true that patients die of paralysis of the heart[1] when no lesion whatever can be traced after death. The paralysis most frequently affects only the muscles of deglutition and of speech, but does also sometimes include nearly all the muscular tissues throughout the body; the sight becomes impaired through loss of the adjusting power of the eye,[2] the pulse fails, apparently from diminished nervous energy in the heart, the legs and arms become partially powerless, and sensations of tingling and numbness are complained of, or actual anæsthesia exists.

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[1] Diphtheria, its Symptoms and Treatment, by Wm. Jenner, M.D., pp. 42–59.

[2] Diphtheria, by E. H. Greenhow, M.D., p. 229.

Diphtheritic fever.—The primary action of the poison when imbibed into the system is an alteration in the character of the blood. This we infer, in the first place, from the sense of malaise, the febrile action, in some instances very slight indeed, but in some very severe, which can be traced before any local manifestation occurs. This fever alone may kill, and when it does so, it is always by its assuming an asthenic or typhoid character; the patient either becomes daily weaker, and ultimately dies of exhaustion, or the case is marked by low muttering delirium, with a tendency to slough about the inflamed mucous membrane, excessive prostration, and rapid sinking; in either case the pulse is feeble and very frequent. It is to be borne in mind that this is the invariable character of the disease, however inflammatory the fever may in the first instance seem to be. In the second place, we infer the existence of blood-poisoning from the occasional appearance of purpura and sanious exudations in fatal cases, and the constant sequel of intense anæmia, even in comparatively mild cases, during convalescence.

These peculiarities are very striking, because the depression resulting from the attack is out of all proportion to its severity, and even when the fever is manifestly typhoid in its character, the subsequent weakness seems very much greater than might have been anticipated, and may end in a gradual but total failure of vital power after all danger had seemed to be at an end.

The fibrinous exudation.—The next immediate effect of the poison is the local action on the mucous membrane of the throat, which looks from the first swollen and red, as if it were the seat of active inflammation. And such no doubt it is; but it is a specific, and not an ordinary inflammation. It is quite different in its character and consequences from the ordinary inflammation of mucous membrane, and bears some analogy to that which is more commonly restricted to serous membrane; differing from it most, perhaps, in its tendency to localization. We are all perfectly familiar with the rapid spread of the inflammatory blush, from a single point, over the whole involutions of the peritoneum, with its sticky, glazy, and fibrinous exudation; we see the same exudation forming a thick shreddy coating all over the heart, or lining the entire cavity of the pleura. In diphtheria we have the same character marking the exudation, but the parts involved do not extend as far as the limits of the membrane. In many cases the patches of lymph are few and small, and the inflammation is confined to the back of the throat. In a certain number of instances the trachea, and even the bronchi, are involved;
unfrequently the membrane lining
nares is attacked more or less extensive
more rarely the exudation travels do
the œsophagus; and in a few cases
reaches up the lacrymal duct to the s
face of the eye. The laws of its ext
sion seem to be much more in harmo
with those of mucous than of serous
flammations, and there is but little dif
ence in this respect between diphthe
and ordinary sore throat, which n
either be limited to the fauces, or may
the commencement of a catarrh, end
in general bronchitis. The character
the exudation varies much in the sa
manner. When the extent of inflar
surface is small, the effusion is scar
and the deposit of fibrin of less thickn
and consistency; when the inflammat
is more extensive, it is generally
more intense, and the effusion is thic
and denser, deeper and firmer. But th
is no absolute rule in this respect.
fibrin is exactly analogous to that wh
usually covers inflamed serous membr
presenting not only the same general
pearances, but also the same microsc
cal elements.

It was at one time supposed that
discovery of a microscopic fungus
given an explanation of the whole path
gy of diphtheria. Competent obser
have, however, shown, not only that
exudation may exist without any trac
the parasite in its substance, but also
the very same form of vegetable life
be seen occasionally in some of the se
tions of the mouth when no sympt
of diphtheria, and no exudation of fil
had been present.

The ordinary consistence of the effu
is such that it is often called false m
brane; but it is sometimes scarcely
cohesive than paste, and contains
granular matter and cells than fibre i
structure. The mucous membrane
which it rests is almost always re
than usual; and when the fibrinous l
is removed, it looks raw and irritabl
if denuded of its epithelium; it is
erally also dotted over with bloody p
where the adhesion has been close
the exudation has entered the mu
follicles, and torn the tissue in it
moval.

The diphtheritic exudation is not,
ever, confined to the mucous memb
of the throat, although probably al
to be found there in a true case of
theria. It is to be seen very const
on the skin when the cuticle has bee
moved by a blister; and it is alleged
the contagion of the disease has spre
this way to persons who have had
ters applied while living in rooms w
others have been suffering from

theria. Any ulcerated or abraded surface, in persons laboring under the disease, may similarly become coated with false membrane; and not unfrequently the mucous membrane of the pudenda in female children is the seat of a similar exudation. Suppuration of an unhealthy kind sometimes attacks the mucous membrane beneath the exudation, which melts away with a gangrenous odor, leaving a slough or a foul ulcerated surface behind; and then the whole course of the disease may be changed, and the patient may fall into that low typhoid condition which is believed to be caused by the absorption of unhealthy pus.

The mere fact of exudation having taken place, apart from its value as an indication of the severity of the attack, claims our most earnest attention, from its occasional bearing on the issue of the case as a local complication. It is not the extent of surface attacked which excites apprehension, but the importance to life of the narrow chink through which air is drawn into the lungs, and the readiness with which a very small amount of thickening, or a very slight deposit on the membrane covering the chordæ vocales, may obstruct the entrance of air, and cause death by suffocation. It would appear that in different epidemics the tendency of the inflammation to spread to the larynx has varied very greatly; sometimes a majority, sometimes but a small number of the deaths resulting from this circumstance.

It is at this point that the epidemic disease comes into close relationship to the endemic inflammation of the trachea in children, known as croup. The termination of the case when death results from apnœa is identical in both diseases; the fibrinous exudation, so unusual in inflammation of mucous membrane, is also apparently identical; but, so far as we know, the cause is different. The diseases appear to be entirely distinct: the one communicable, the other having no tendency to spread; the one a simple inflammation, the other a specific fever; the general disturbance in the one case only such as is produced by the local inflammation and the difficulty of breathing, while in the other the local disorder is only one manifestation among many of a previously existing condition of blood-poisoning by which the fever is caused.

Treatment.—The fatal termination of an attack of diphtheria may follow either as a remote or immediate result of the fever itself, or in consequence of the obstruction of the larynx by local exudation; and the treatment must vary as the one or the other of these circumstances seems to be the most fraught with danger. Like the other acute specific diseases, diphtheria must be treated on general principles, inasmuch as no specific remedies have yet been discovered which have the power of destroying the blood-poisons on which they severally depend. Probably no such remedies exist. The condition of the blood during the incubation of a fever, while an infinitesimal portion only of the poison has been absorbed, must be very different from that in which the poison is again generated in unmeasured quantity, and is passing off from the patient's body to attack others who are brought within its range; and a remedy which might avail in the one condition would be useless in the other. If, as we apprehend, diphtheria is in this respect analogous to smallpox, the plan of treatment must necessarily vary with the duration of the disease, the intensity of the blood-poisoning, and the power of resistance on the part of the patient. Any specific, if such there be, can only act as a preventive, hindering the blood-changes from commencing, and cannot very well be supposed to put a stop to their progress when fully developed. The spoilt material can only be got rid of by elimination; fresh blood must be formed to take the place of that which has undergone a process of deterioration. On these broad principles must our treatment be based with reference to the fever itself; the local disease demands separate attention and different remedies.

1. In some rare cases the patient is at once prostrated by the severity of the fever; he has a brown tongue, a quick and feeble pulse, probably purpurous spots on his body, or a sanious discharge from the nose or fauces, and occasionally muttering delirium. Such cases rarely show any signs of rallying; and the freest use of stimulants affords the only chance of saving the patient or enabling him to recover from the shock of the attack.

2. If not thus prostrate from the very first, yet generally from an early period the tendency of the disease is to assume a low or asthenic type; and depressant remedies must be carefully avoided. In some cases the local inflammation is severe, and the fever is proportionately acute, and for a few days mild salines may be indicated; but even such treatment must not be persevered in too long, and the depression which follows must be met or even forestalled by the administration of stimulants. The difficulty of swallowing must not be permitted to interfere with the quantity of nourishment taken; patients who escape the first severity of the disease are still exposed to the danger of a lingering convalescence, or a gradual exhaustion of the vital powers; and hence the importance of a sustaining mode of treatment. Chlorate of potash, hydrochloric acid, and muriated tincture of

iron, are the constitutional remedies on which, according to the testimony of most writers, the greatest reliance is to be placed, combining them with diffusible stimuli or tonics, as the particular case seems to require. Each has been vaunted in turn as almost specific, and each has notably failed where it has been so misapplied. Chlorate of potash acts so completely as a charm in some cases of cancrum oris, that it is not unreasonable to suppose it may act beneficially where there is any analogous condition of the mucous membrane; in the purely non-ulcerated form of diphtheria, it is less likely to do good. Hydrochloric acid, either alone or in combination with the chlorate, is well known as a gargle and drink in scarlet fever. It seems to act partly as a local stimulus to the throat, and partly as a general blood alterative, especially in those forms of the disease in which the appearance of purpura or sanious discharge proves that important changes have taken place in the condition of the blood. Iron in all its forms is so distinctly the remedy which tends to restore the blood to its healthy condition, that its use cannot be dispensed with in a disease of which blood-changes are the commencement, and anæmia the usual termination. The tincture of the perchloride has appeared to act most beneficially in some cases of erysipelas, and its local astringent action seems to render it especially suited for the treatment of this disease. In some cases it has certainly answered even beyond expectation. [Chlorate of potash and tincture of iron are best prescribed in separate mixtures, to be given alternately, or mingled, at the time of administering, in such proportions as the medical attendant may direct. The iron must be given frequently, and in decided doses, say ten to sixty drops every two hours, hour, or half hour. The chlorate of potash should be given in doses of from two to twenty grains at similar intervals; care being taken to watch for any evidence of nephritic irritation, and to suspend it at once should such complication be threatened.]

3. Foul and unhealthy suppuration not only aggravates the general disorder, but may lead to the supervention of blood-poisoning of another kind. Pyæmia, as it is called, must be regarded as a most dangerous complication of diphtheria. Ulceration of the mucous membrane shows that the vitality of the patient is low, and calls for increased activity in the administration of stimulants and tonic remedies, while every attempt is made to convert the foul suppuration into a healthy sore, to prevent the possibility of the absorption of unhealthy pus into the system. If secondary abscesses begin to form, the liberal employment of wine and brandy, with large doses of opium, gives the only chance of recovery. The extent to which both opiates and stimulants are borne in such cases is quite surprising.

4. The local disorder claims our attention more especially when it spreads towards the larynx and trachea. The idea that the extent of the exudation was the cause of the severity of the symptoms has been entirely abandoned, and with it that meddlesome activity which deemed it necessary to apply caustics or astringents several times a day to the throat. An abraded surface, whether of cuticle or of mucous membrane, is speedily covered with the diphtheric exudation in the severer forms of the disease, even when no contact of parts is possible; and it would seem perfect madness to apply an escharotic which tends to denude the adjacent membrane of its epithelium, and prepare it for the fibrinous exudation which is certain to take its place. Such treatment, however, has been adopted, under the mistaken idea that local means could check the constitutional malady. The circumstances which seem to demand local applications are the rapid spread of the exudation, and the existence of ulceration. The application must be astringent, not escharotic; a stimulant to the diseased surface, not a destroyer of its vitality. By occasional sponging with a solution of the perchloride, or a very dilute mineral acid, or a weak solution of lunar caustic, we may hope to prevent the exudation reaching the larynx, or the ulceration assuming an unhealthy character; but the power of such means is allowed on all hands to be very limited.

[Inhalation of the fumes of lime in process of slaking is often efficient in securing detachment of morbid products from the air-passages, and their expulsion by cough. This method should always be tried, when time permits, before resorting to direct surgical procedure. Pending the resort to the lime, the vapor of steaming water may be inhaled, evolved from a special kettle, or from a pan of water heated by a portable stove of some kind by the side of the bed. In either instance the vapor can be directed towards the mouth of the patient by a funnel-shaped cowl extemporized from stiff paper.

Sprays of lime-water, lactic acid, bromide, and other drugs, are sometimes very useful for the same purpose; but the slaking lime seems by far the most reliable agent.]

When the larynx is also involved in the exudation, dyspnœa, and insufficient aëration of blood, add very materially to the sufferings of the patient, and the probability of a fatal termination; and the question naturally presents itself, whether any, and how much, benefit may be anticipated from the operation of tracheotomy. It is by no means easy to give in few words a definite answer to this inquiry, or to lay down rules which may be sufficient to guide the practitioner in deciding on his course. If we turn to statistics, we find that the fatal termination is not averted to any great extent, although in all probability some lives have been saved by the operation, which must otherwise have been lost. But it is manifestly impossible to frame a series of cases in which it has not been performed which shall be an exact counterpart to those operated upon; and without such a basis of comparison, the knowledge of the exact number of deaths and recoveries after operation is valueless. It is indeed asserted that of late years the mortality in France after tracheotomy is not nearly so great as formerly; but this may depend not so much on the results being more favorable, as on a more hopeful series of cases being selected. In such circumstances we must be guided more by general principles than by experience, and the rules for our guidance must be admitted to be based partly on conjecture. It may be assumed, then, first of all, with tolerable confidence, that when the general symptoms indicate that the attack is comparatively mild, while the danger of suffocation is imminent, tracheotomy does give a chance of life in cases otherwise all but hopeless, and that it certainly does give prompt and certain relief to the suffering immediately caused by dyspnœa, than which nothing is harder to bear. But no surgeon ought to undertake the operation, even in such circumstances, without fully explaining that relief, and relief only, from impending suffocation is its object. Secondly, when the dyspnœa is less intense, it becomes a question, whether the relief to the breathing may not help forward the process of cure which nature is working out; or it may rather be said, whether the existing amount of dyspnœa does not materially hinder the recovery, and render it more uncertain. The French surgeons are disposed to answer in the affirmative; and the opinion is shared by many among ourselves; but the practice is clearly not one that can be urged as necessary in the present state of our knowledge. Thirdly, in the very severe forms of the disease, we may well pause before recommending the operation, because it is no longer a question of the possible saving of life, but one merely of giving temporary relief. The patient is in a condition most unfavorable for the operation; and even setting aside the chances of an immediately fatal result, the fact of the operation having been performed is very apt to tell unfavorably on the issue. In addition to this, we must remember that the operation may even fail of giving relief in consequence of the trachea and bronchi being blocked up by false membrane. In such cases it can only be justified by intense dyspnœa and impending suffocation, and by the earnest longing of the patient, or the friends, to have something done to procure relief. Could we know with any degree of certainty how far the exudation extended into the trachea and bronchial tubes, we should have most valuable information to guide our decision. Auscultation should with this view always be carefully practised; but it must be confessed that the determination is a matter of extreme difficulty, and one in which the most experienced stethoscopist may fail to elicit any accurate or trustworthy information.

5. During the prevalence of the epidemic many slight cases occur, which assume more or less its specific characters, and are marked by the presence of small shreds of lymph on the fauces. An ordinary sore throat at such times does not follow its usual course, but without manifest exposure to infection is somehow assimilated to diphtheria. These generally require no special treatment, and will in all probability end in recovery without the aid of medicine. We have only to remember the tendency to depression which accompanies all the well-marked instances of the disease, and therefore in all cases we must carefully avoid any lowering remedies. No good can result from the local application of escharotics, while some risk is run of causing the exudation to spread more than it would otherwise do. Many a diphtheritic-looking throat has been produced by the unnecessary application of lunar caustic in doubtful cases.

CROUP.

General characters.—With the disease known by the name of croup, or tracheitis, as it has been sometimes called, the cynanche trachealis of Cullen, English medical men have been long familiar. Although occurring in particular localities at certain times with greater frequency than elsewhere, it presents none of the true features of an epidemic; it is much more truly endemic. It appears chiefly during the cold weather; it may visit the same locality year after year, wholly disappearing during the interval; but it does not spread to adjacent houses or villages, its victims being comparatively few, although several persons are usually attacked at or about the same time. In all these respects it has much more affinity with pneumonia than with such a disorder as diphtheria. Like the latter, however, it is marked by one very striking feature, viz., the existence, in a large number of instances, of false membrane as an exudation from a mucous surface.

With our present knowledge it is impossible to assign any reason for this peculiarity. There is no specific poison apparently introduced; the mucous membrane lining the larynx and trachea is simply inflamed; and in many cases the exudation is purulent or creamy-looking; but in the majority it is fibrinous, contrary to the usual laws governing the inflammations of mucous membrane. Why this is so, we know not; for an acute attack of bronchitis or lobular pneumonia, both not uncommon in children of the same age, is not attended by the same sort of exudation from the mucous surface of the small tubes. It is usually only when the inflammation attacks the trachea, and is localized there, that false membrane is formed; but cases are occasionally met with in which the same material may be found lining the bronchial tubes down to their minutest ramifications. It is scarcely to be hoped that we shall ever attain to a knowledge of the circumstances which determine why one exposure to cold is followed by inflammation of the parenchyma of the lungs, another by that of the lining of the small tubes, while in a third the membrane of the trachea is alone the seat of the inflammation. It is this tendency to limitation which constitutes the specific character of each inflammation, and thus distinguishes croup from laryngitis on the one side, and bronchitis on the other. The peculiar form of the exudation is not less characteristic of croup when it is observed, inasmuch as it does not accompany the other forms of pulmonary inflammation; but it is never safe to take any one symptom as pathognomonic of a disease, however close the relationship; and mistakes are constantly being made by those who rest satisfied with such methods of diagnosis.

The attack ordinarily sets in with acute febrile symptoms and a hard dry cough, which has a very peculiar sharp ringing sound, dependent on the changes which from the first occur in the larynx and trachea. The sound of the cough is so remarkable, that, when a child produces this brassy tone in coughing, the attendant is tempted to conclude, without further inquiry, that the disease is croup. There is very generally no difficulty in swallowing, any feeling of soreness of throat being confined to the windpipe, and not reaching the fauces. In some few instances, however, the inflammation is more general, and false membrane is seen on the tonsils and the back of the throat, just as ordinarily happen
theria. The breathing is alway
partly as a consequence of th
state, partly because air enters
with difficulty. As the disease
this difficulty increases, and the
recurs in paroxysms, which beco
hour more distressing. Such p
often follow a fit of coughing,
sionally come on without any
cause. In the expectoration
false membrane are often seen,
siderable relief sometimes follo
moval; but in the severer for
disease the relief is only tempo
exudation is renewed as soon as
jected, the breathing becomes
more oppressed, the skin acquire
hue, and ultimately is covered
perspiration. After several se
ineffectual struggles for breath,
seems to be stupefied by the circ
imperfectly-ventilated blood, an
tient sinks into unconsciousness.

Diagnosis.—The site of the
tion is specially the trachea; bu
fatality depends upon its invol
the larynx; and this circumst
rects our attention to the infla
action going on in that part of th
ing apparatus more than to the
of the trachea itself. Laryngiti
ease of adult life; tracheitis is
childhood: hence, if the dif
breathing is caused by some co
the larynx, we almost at onc
that in an adult we have to
laryngitis, in a child with cro
febrile symptoms are present, an
nothing visible about the thro
count for the dyspnœa. Indeed
hardly go any further in disti
these two diseases, because if fal
brane be present, its appearan
expectoration will very soon re
doubt. From bronchitis and p
it is distinguished by the coug
existence of dyspnœa, and by th
this dyspnœa being traceable
larynx. The spurious or false
much more sudden in its onset,
sient in its character; the one
essentially febrile and inflamma
other spasmodic, free from fever,
pendent on nervous irritability.
diphtheria and croup the relation
close; and although it be quite
the original site of the exudativ
mation is in the former the fauce
latter the trachea, yet there are
in which at present the name giv
attack must depend simply on
sideration. whether the case
sporadically or was one of such
as could only be caused by epid
fluence. The cases which cann
termined by this rule are comp

few; and during an epidemic, genuine cases of croup may very generally be distinguished, even though the epidemic element impresses on them, to a certain extent, its own characters and features. The chief symptoms which must be relied on for this discrimination are also those on which the treatment of the two forms of disorder is in great measure based; they are those which characterize the one as a fever, and the other as an inflammation. How much there is in such a distinction those only can tell who, regardless of theories, watch the actual condition of patients under either form of disease, and can feel assured, as they certainly may be, of the benefits of depletion and starvation in the one case, of the absolute necessity for supporting and sustaining in the other. The state of the skin and the pulse help us more in this matter than any other set of symptoms; fever is associated with more burning and pungent heat of skin, with greater frequency and less power of pulse from the earliest period of the attack, and is not often associated with perspiration. But though these point the way with reference to treatment, it is by constant and repeated observation alone that we learn in each case how far the type of the disease is of a sthenic character, and are able to determine whether the patient will bear for a little while mere watching and starvation, or his tendency to prostration is such as demands our using from the first every means of support.

Treatment.—Treatment embraces especially two points: 1st, the arrest of the inflammatory action; 2d, the relief of the breathing. We cannot in this disease very often wait for such a change in the condition of the membrane as shall of itself bring relief to the breathing; the patient may die of suffocation before the inflammation subsides, however energetic our remedies may be. The state of the skin and pulse, and the hurry of the breathing, lead us most naturally to salines and antimony, as the best means of accomplishing this end. If the patient be healthy and robust, a few leeches to the top of the sternum aid in emptying the vessels and checking the exudation. The extent to which these remedies are employed must depend mainly on the constitutional strength of the patient; and in the event of diphtheria prevailing at the time, their employment must be still more sparing, because of the known tendency to depression which accompanies it, and seems to modify very much, for the time being, any coincident cases of sporadic croup. But even without any such complication, the mere fact of severe inflammatory action, with its exhausting and debilitating effects on the constitution, must put us on our guard against allowing the patient to be too much lowered by depletion, and demands a supporting plan of treatment at a comparatively early period when it occurs in the susceptible and rapidly-changing structures of childhood. The intention of this part of treatment is, if possible, to limit the febrile action before such an amount of exudation has been poured out as may run the risk of producing fatal suffocation; we do not hope or expect to arrest it altogether.

Mercury has so long enjoyed a reputation as the most powerful solvent of fibrinous exudations, that it is almost always given in croup; but one decided objection presents itself, that its action is too slow to be very available. If the patient survive long enough to be brought fully under its influence, the probability in favor of recovery is already considerable, and the result ought not to be set down to the mercury in very many cases in which it is given. Its usefulness is perhaps rather to be attributed to its action on the excretory functions.

[In the United States, the mercurial is very frequently combined with soda.]

The difficulty of breathing depends in very great measure on the condition of the larynx, and is to be explained partly by the simple fact of congestion, partly by the presence of false membrane. The depressant remedies will aid in relieving the congestion and preventing the renewal of exudation, but are powerless to remove the false membrane; occasional benefit, however, is obtained by their administration in emetic doses, which, especially with children, seem to clear out the trachea while emptying the stomach. [Inhalations of slaking lime often detach the morbid product. The vapor of water alone is sometimes sufficient for the purpose, and means for maintaining its evolution will readily suggest themselves to the professional attendant.] Our chief reliance where prompt relief to the breathing is demanded, and seems an unavoidable necessity, must be in the operation of tracheotomy. It is certainly more adapted to this disease than to diphtheria, in so far as the attack is local instead of constitutional, is an inflammation and not a blood-poisoning. The principal objection to its employment is found in the fact that the false membrane is rarely limited to the trachea, but also partly descends the bronchi; and hence that while sometimes a sufficient amount of air is admitted into the trachea, it cannot reach the lungs, because the bronchial tubes are choked up. English medical men seem now very generally to incline to the opinion that the operation, if not to be recommended, is at least justifiable, as it does

not materially increase the risk of a fatal issue, and unquestionably in some cases offers the only chance of recovery; but, to be successful, it must be performed at an early period of the attack. Such a practice is likely to meet with much opposition, from the prejudices of friends, who cannot see that there is any need for its performance; and, out of deference to their wishes, the operation is too often postponed to so late a period that it does little or no good. No operation of course can be undertaken without some risk; but the risk attending tracheotomy must be greatly increased if it is to be done in a hurry, with the immediate prospect of life being terminated by suffocation if the final plunge of the knife into the windpipe be a moment delayed. At the same
time the chance of ultimate recovery
very much diminished if the blood i
become thoroughly poisoned with un
pired carbonic-acid gas. The stethosc
may do something, but it cannot do mu
in determining the question of how
the minute tubes are obstructed. T
noise produced in the larynx and trac
generally drowns every other that mi
be heard; but if crepitation be distin
audible, indicating that inflammat
action is not limited to the trachea
the large tubes, to undertake the op
tion of tracheotomy would be quite
justifiable, except for the purpose of sa
fying the urgent desire of patients
friends, who ought to be informed t
no countervailing benefit can be loo
for to compensate the risk.

DISEASES OF THE LARYNX.

BY ARTHUR E. DURHAM, ESQ.

Revised by J. SOLIS COHEN, M.D.

IN Laryngeal Diseases the ordinary symptoms, such as pain, cough, difficulty in breathing and in swallowing, alteration of the voice, etc., often fail to indicate the precise nature and seat of the malady.

Moreover, irritation of or pressure upon the recurrent or other nerves by tumors, aneurisms, etc., as well as certain morbid conditions of the nervous system generally, may give rise to symptoms which more or less closely simulate those produced by actual disease of the larynx itself. Hence it constantly happens that some aid to diagnosis must be obtained, or the treatment adopted is as likely to be as unsuccessful in result as it is necessarily uncertain in direction. Such aid is afforded by the laryngoscope. This instrument was suggested—indeed repeatedly suggested—many years ago, but it has only recently come into general use. Its great value as an aid in the diagnosis and treatment of diseases of the larynx, though fully established, was not yet generally recognized and appreciated when the first edition of this work was published.

Historical details relative to the invention of the laryngoscope would be altogether out of place in these pages.[1] It
may, however, be stated that Dr. B.
Babington appears to have just cla
to be considered the first succes
laryngoscopist.[1] Further, it is imposs
to omit an expression of grateful ackn
edgment of the labors of Professor C
mak, formerly of Pesth.[2] To him, p

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[1] The history of Laryngoscopy is more or less completely discussed in the following works: The Use of the Laryngoscope, by
Morell Mackenzie, M.D., 2d edit., Lon
1866. The Laryngoscope in Diseases of
Throat, by Sir G. D. Gibb, M.D., 3d edit., 1
Art. by Mr. Windsor in the Med.-Chir. Rev
Jan., 1863. Art. Laryngoscope in the I
encyclop. des Sciences médicales. P
1868. Klinik der Krankheiten des K
kopfes, by Dr. Ludwig Türck. Wien, 1
Die Laryngoskopie, by Dr. Bruns. Tubin
1865. Lehrbuch der Laryngoskopie, by
Tobold. Berlin, 1863. In these works
also be found much valuable informa
relative to the construction and prac
uses of the laryngoscope, as well as to
diagnosis and treatment of Diseases of
Larynx. Constant reference has been
to them in preparing the following pages.

[1] London Medical Gazette, vol. iii., p.
London, 1829.

[2] Zeitschr. der Ges. der Aertze, No. 17.
Kehlkopfspiegel und seine Verwerthung
Physiologie and Medizin. Leipzig, 1860.
Laryngoscope. Paris, 1860. A translati
this work was published by the Syden
Society in 1861. Also many subsequent
tributions to foreign and British journals

ably more than to any one else, we are indebted for the earliest complete demonstration of the general practicability and value of laryngoscopical examinations, and the best methods of making them, and still more, perhaps, for the disinterested and painstaking manner in which, both on the Continent and in this country, he has published his results, and personally taught his method.

LARYNGOSCOPY.

The laryngoscope essentially consists of the laryngeal speculum, together with some contrivance by means of which a good light can be thrown upon it, when introduced into proper position in the pharynx.

The laryngeal speculum is a small plane mirror, fixed to one extremity of a slender but strong stem of sufficient length. The other extremity of the stem is fitted into a light handle, either permanently, or in such manner that it can be removed or changed at will. The mirror may be made of polished steel, speculum metal, or silver; or it may be made of silvered glass (looking-glass) mounted in a thin metal frame. The metallic mirrors are readily warmed, retain their heat well, and are so thin as to occupy but little space. On the other hand, the silvered glass mirrors are much less liable to get tarnished or scratched; no practical disadvantage arises from their comparative thickness, and there is no difficulty in keeping them of such temperature as to prevent the deposition of moisture upon them. They are, therefore, as a rule to be preferred.

In shape the mirror may be circular, ovate, elliptical, or quadrilateral with rounded angles. The three first named forms are recommended by Türck,[1] the last by Czermak.[2] For all ordinary examinations the circular and quadrilateral forms are the best, and they answer equally well. In cases, however, in which it may be necessary to carry the speculum deeply into the pharynx, or in cases in which the tonsils are much enlarged, the ovate or elliptical form is preferable.

The mirrors ordinarily supplied by the makers vary in diameter from half an inch to an inch or more. In every case the larger the mirror that can be employed, the better is the general view obtained. The stem should be straight, or only slightly curved, and four or five inches in length. It should form with the diameter of the mirror drawn to its point of junction an angle of from 120° to 125°. Moreover the mirror should be so inclined as to look somewhat downwards when the stem is held horizontally. It is advantageous to have the stem of such material that it may be bent in one direction or the other, so that different degrees of inclination may be given to the mirror according to the requirements of the case under examination.

[A flexible stem is often a nuisance in practice. It is apt to be bowed by powerful palatine muscles and thus deflect the illumination. The natural movements of the wrist supply all the motion necessary for adjusting the inclination of the mirror.]

For the illumination of the speculum when in position either direct or reflected light may be employed. But in either case, if the light should not be very powerful, concentration of the rays is desirable.

Direct sunlight answers perfectly, but is seldom available. Some other source of light *must* frequently, and *may* always be employed. Diffused daylight is rarely, if ever, sufficiently powerful. The light of a lamp concentrated by means of a glass globe filled with water—both lamp and globe being placed behind the observer, the light coming over his shoulder, was formerly recommended by Turck.[1] A somewhat similar but improved arrangement is advocated by Dr. Walker, of Peterborough.[2] But the inconveniences of any such method are obvious. Moura-Bourouillou describes, in his treatise on Laryngoscopy,[3] an instrument which he names the "Pharyngoscope." This consists of a large biconvex lens capable of bringing to a short focus the rays of light from a powerful lamp, to the stand of which it is so connected as to be easily adjusted, and moved in various directions. The whole apparatus is placed between the patient and the observer, who looks by one or other side of it. A slight modification of this arrangement is commonly used in Paris, and is recommended by Krishaber.[4] The modification consists in the addition of a concave reflector behind the light, and a shade which surrounds the lamp to such an extent as to protect the eyes of the observer from any direct rays. The condensing lens, the reflector, and the shade, are all attached to a metal ring, which is capable of being adapted and fixed by screws to almost any lamp.

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[1] Méthode pratique de Laryngoscopie, par le docteur Türck. Paris, 1861; and op. cit., p. 38.

[2] Du Laryngoscope, par le docteur Czermak. Paris, 1860.

[1] Türck, Zeitschr. der Ges. der Aertze, No. 26, 1858.

[2] The Laryngoscope and its Clinical Application, by T. J. Walker, M.D. T. Richards. London.

[3] Cours complet de Laryngoscopie. Paris, 1861.

[4] See Krishaber, in the Dictionnaire encyclopédique des Sciences médicales. Art. Laryngoscope. Paris, 1868.

Various other contrivances have been from time to time adopted for the direct illumination of the laryngeal speculum. But all are open to the objections that in their application the direction of the light is too little under the ready control of the surgeon; and too much depends upon the maintenance of the patient in proper position. He cannot be examined when recumbent. Moreover, the head of the surgeon is apt to obstruct the light if its source is behind him; and the lamp may be awkwardly in the way if placed in front of him. These and other objections are more or less completely avoided by employing reflected light for the illumination of the speculum. Czermak first suggested the use of a modification of Ruete's large ophthalmoscopic reflector for this purpose. And some such method as that which he originally suggested still appears the most convenient and most generally applicable. At any rate it is the method commonly adopted in this country and in Germany.

[Attempts have been made in Europe and America to utilize electricity as an illuminating agent, both by incandescence of platinum wire, and by incandescence of vacuum; but these efforts, though promising, are as yet by no means successes.]

The source of light is placed on one side of and somewhat behind the head of the patient, who should, if practicable, be seated near the corner of a table. The rays are then reflected from and concentrated by a circular concave mirror duly arranged immediately in front of the face of the surgeon. The mirror should be three or four inches in diameter, and should have a focal distance of about twelve inches. It may be perforated or not in the centre. If perforated it may be placed in front of one eye, and the view may be taken through the perforation. If not perforated it may be arranged in front of the forehead and nose, and between the eyes; or lower down in front of the nose and mouth. In either of these arrangements both eyes may be used; in the former looking below, in the latter above the reflector. The perforated reflector should theoretically give the more perfect view. But practically the imperforate reflector is found to be as efficient in all ordinary cases; and it possesses the great advantage of permitting the equal use of both eyes. The reflector may be held in the hand, when the hand is not required for any other purpose; or it may be supported on a stand in such a manner as to be freely movable in all directions. In Tobold's arrangement it is connected with the stem of the lamp, or the light-concentrator. Generally, however, it is attached to the head of the surgeon by means of a strong spectacle frame, an elastic frontal band, or a steel spring passing over the vertex. The first method is best adapted for the perforated reflector; the second for the imperforate reflector in front of the forehead; and the third if the reflector is worn lower down. Czermak's original plan of fixing the stem of the reflector at right angles to a piece of wood to be held between the teeth may be considered obsolete. In any case the reflector should be connected with its support either by a ball and socket joint, or in such other way as permits it to be turned easily in any required direction.

As a source of light, any lamp which burns with a bright, steady, full bodied flame, may be employed. A good moderator or reading-lamp, or an Argand gas-burner, answers perfectly well for all ordinary purposes. But it is desirable to have the lamp so arranged that it can be raised or lowered in position, and moved from side to side. Mackenzie's "rack movement laryngoscopic lamp,"[1] which readily admits of perpendicular and horizontal movement, is admirably adapted for use in the consulting room.

The light of the lamp may be advantageously concentrated by means of one or more lenses placed in front of the flame, and a concave reflector or white reflecting surface placed behind it. Of all the so-called "light concentrators" which I have seen, I believe Mackenzie's is the best for ordinary use. It consists of a metallic cylinder having a short branch which bears a plano-convex lens two or three inches in diameter. The cylinder replaces the glass chimney of the Argand gas-burner; and its branch is so situated, and of such dimensions, that the lens is opposite the middle of the flame, and receives and concentrates a large body of luminous rays. Dr. George Johnson's light-concentrator has the advantages of portability and readiness of application to any ordinary lamp. It consists of a plano-convex lens, and a concave reflector attached to a metal ring, which by means of a spring clip or screw can be easily fixed to the brass collar of the lamp glass. Tobold's apparatus contains two lenses. It is very efficient in working; but it is heavy and cumbersome, and can only be applied to a lamp especially adapted for it.

For purposes of demonstration, and sometimes in operating, it is advantageous to have command of a more brilliant light than any ordinary lamp can afford. Such a light may be obtained by means of the electric, magnesium, or oxyhydrogen lantern. Of these, the last named, or some modification of it, is most easily available and most manageable. The apparatus employed at the Hospital for Diseases of the Throat answers admirably. The so-called "Medical Lantern" of Dr. Thudichum,[1] which he especially recommends for use in rhinoscopy, is equally adapted for laryngoscopical and other examinations. In this apparatus the hydrogen flame is conveniently replaced by that of a spirit-lamp.

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[1] Made by Mayer and Meltzer.

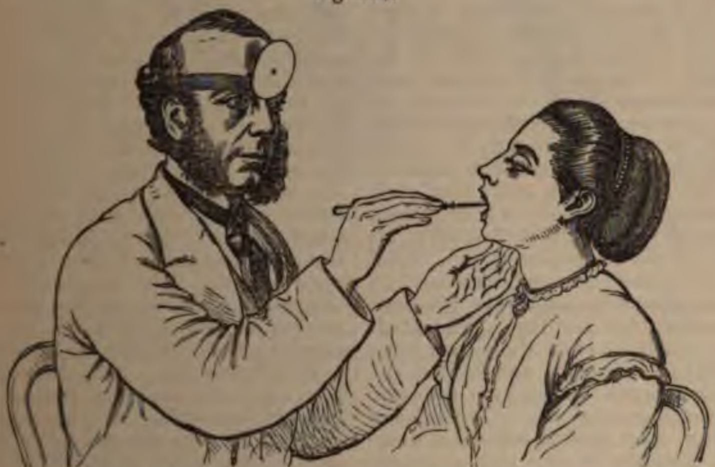
In cases in which the diagnosis is doubtful, or in the treatment of which difficult operative measures are needful, it is sometimes well to wait until sunlight is available. In making an examination by sunlight, a plane rather than a concave reflector should be used. The latter throws too brilliant a light; and moreover the rays concentrated by it may possibly burn the patient if proper care is not taken.

In all cases in which sunlight, or any other powerful light is employed, the eyes of the surgeon should be protected by a plain shade, or by the hollow conical eye protectors,[1] which are figured in use in the chapter on Rhinoscopy (p. 228, fig. 297). If a comparatively feeble light is employed, it is advantageous to darken the room in which the examination is made.

The general arrangements for making an ordinary laryngoscopical examination by means of the reflector and artificial light are represented in fig. 556.

The lamp, the mouth of the patient, and the eyes of the observer should be as nearly as possible in the same plane. If the laryngeal speculum is held in the right hand of the surgeon, the lamp should be placed on the right side of the patient, and *vice versa*. If, as may sometimes be convenient, the lamp is placed above and behind the head of the patient, the vertical plane must be preserved; but the speculum may be held with equal advantage in either hand without risk of obstructing the light.

Fig. 556.



Application of the laryngoscope. The tongue should be drawn forwards (Erichsen).

The patient should if possible be comfortably seated opposite the surgeon in a nearly erect position. His body should lean somewhat forwards, and his head should be inclined slightly backwards; but should not be thrown so far back as is often done. Sometimes it is advantageous to employ a "head rest," which may either be fixed to the back of the chair, or may have a separate stand. When in proper position, the patient is directed to open his mouth as widely as possible, and to breathe quietly but deeply. His tongue may be protruded, and held by himself or by the surgeon, the fingers and thumb being covered by a soft towel or handkerchief to prevent slipping; or it may be kept within the mouth, and gently pressed forwards against the lower teeth, an attempt being made at the same time to depress and flatten or render concave its posterior part. Sometimes one plan, sometimes the other is found to be the more effectual. Meanwhile the surgeon arranges his reflector so as to throw the light into the open mouth of the patient. When he has succeeded in illuminating the middle of the soft palate, the uvula, and posterior pharyngeal wall by a bright disc of light, he may proceed to introduce the laryngeal speculum.

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[1] Made by Orchard, of Kensington. See Thudichum On Polypus of the Nose and Ozæna, p. 5. Churchill, 1869.

[1] Made for me by Messrs. Weiss.

The handle of the speculum should be held somewhat "pen-like" between the thumb and the fore and middle fingers of one hand or the other. The speculum should be slightly warmed previous to its introduction, either [by holding the reflecting surface] over the lamp [until the condensed moisture is dissipated from it] or by momentary immersion in hot water, in order to prevent deposition of moisture upon its surface.[1] Care must be taken, however, that it is not made too hot. Its temperature may be easily tested by the hand or cheek of the surgeon. [For personal safety, the hand is far preferable to the cheek.] The speculum should be introduced with its reflecting surface directed downwards and forwards. It should be carried backwards through the cavity of the mouth, deliberately, confidently, and steadily, and then applied with gentle but firm pressure against the uvula and neighboring portions of the soft palate. Uncertain, hesitating, and hasty movements of the instrument are liable to give rise to objectionable titillation. In its passage through the mouth it should not come in contact with the tongue, nor indeed with any other parts than those against which it is to be placed. As a rule it should not be carried so far back as to touch the posterior pharyngeal wall. Sometimes, however, especially in certain exceptional cases, this may be done with considerable advantage. [The editor almosts invariably rests the mirror upon the wall of the pharynx, and finds it the most advantageous method, as the rule, rather than the exception.] The hand of the surgeon must be kept somewhat down and well towards its own side, so as not to obstruct the light. The third and fourth fingers may rest against the chin or cheek of the patient. [When the mirror rests upon the pharynx there is no occasion to support the fingers upon the face of the patient.] The stem of the instrument should lie in or near to the corresponding angle of the mouth [or directly in the middle line, as may be most convenient]. In a large proportion of cases no difficulty is encountered, and the patient suffers comparatively little inconvenience.

When the speculum is thus placed in position and well illuminated, it exhibi
to the surgeon images of those parts
the larynx upon which the rays reflecte
from its surface are made to fall. It mu
be borne in mind, however, that as
necessary consequence of the position
the mirror in relation to the eye of t
observer on the one hand, and to t
larynx of the patient on the other, t
parts appear in the image as though
versed antero-posteriorly. And they a
thus conventionally represented in
ordinary laryngoscopic diagrams.

This so called "reversal" or "inversio
of the image is illustrated by fig. 557 (
41), in which B diagrammatically rep
sents the parts as seen when simply look
down upon, and A the same parts as th
appear reflected in the mirror. No pr
tical difficulty or inconvenience resu
from this apparent inversion.

By varying the inclination of the m
ror, and slightly changing its positi
from time to time, the following parts,
rather certain portions of them, may
successively brought into view; the b
of the tongue and glosso-epiglottid
ligaments; the epiglottis and aryte
epiglottidean ligaments; the cartilage
Santorini, and the arytenoid cartila
the true and false vocal cords; the v
tricles and anterior wall of the lary
more or less of the anterior wall of
trachea; and if the glottis is very wid
open and the light very good, even
bifurcation of the trachea, and a s
portion of the right bronchus. Th
several parts, however, cannot all be s
with equal facility. Numerous rules h
been laid down as to the position and
gree of inclination of the mirror
adapted for the special examinatio
each particular part.[1] But it is needles
repeat them. A correct knowledge of
relative positions and natural appeara
of the parts, and a consideration of
simplest laws of catoptrics, together
a certain amount of practical experie
will enable the laryngoscopist to b
into view and recognize one part a
another so far as may be practicable.
peated attempts are often necessary be
even partial success can be attai
And sometimes even the utmost pe
verance only results in failure. But
need rarely happen. The possible sou
of difficulty are numerous, and the ac
difficulties may be great; but they
generally be obviated or overcome, at
rate to some extent, by patience
judicious management. Those who s
from chronic laryngeal affections are

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[1] Various expedients have been suggested with a similar view. Thus, Dr. H. G. Wright contrived a speculum, the temperature of which was maintained by a wire placed behind the mirror and heated by galvanic action. Dr. Buzzard recommends that the surface of the mirror should be covered with a film of glycerine. But no plan answers better than the simple one above-mentioned; nor is any other so easy of application.

[1] Krishaber, Art. Laryngoscope, in
encyclop. Op. cit., p. 497 et seq. Türck
cit. and Méthode pratique de Laryngosc
Paris, 1861.

Fig. 557.

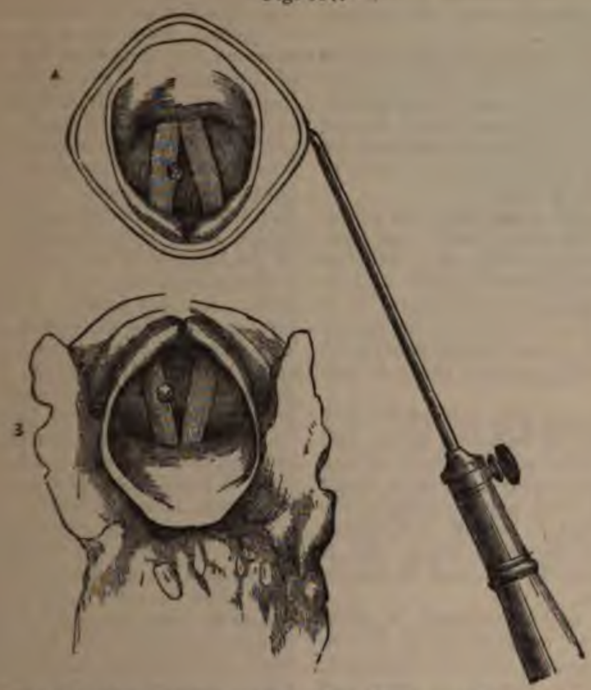

Diagram illustrating the antero-posterior reversal of the laryngoscopic image. The small excrescence situated on the right vocal cord (B) might be falsely supposed to be on the left from the appearance presented in the mirror (A).

rule the best subjects for laryngoscopic examination—not the worst, as might be supposed. Their desire for benefit affords a stronger stimulus to patience and self-control than can actuate the healthy; and, moreover, they are usually accustomed to expose their fauces for inspection, and to submit to local applications, by which indeed the normal sensitiveness of the parts may have been diminished.

The most common sources of difficulty are as follows: general nervousness and excitability of the patient; fancied or real inability on his part to open his mouth sufficiently wide, and awkwardness in the management of his tongue; relative largeness, or some swollen condition of the tongue; malformation or deformity of the soft palate and neighboring parts from ulcerative disease, and subsequent contraction of cicatrices; elongation and thickening of the uvula; enlargement of the tonsils; pendency of the epiglottis; and, lastly, extreme sensitiveness of the uvula and soft palate, either natural or resulting from existing inflammation or ulceration.

Difficulties arising from the first three sources may be overcome almost invariably by patience and judicious management on the part of the surgeon, and a little practice on the part of the patient. Hastiness in manner, and in method of proceeding, should be avoided; and every effort should be made to encourage, reassure, and inspire confidence. By his own example the surgeon should show the patient how to open his mouth, and should demonstrate the slightness of the inconvenience caused by the introduction of the speculum. If proper directions are given, and the patient is induced to practise occasionally by himself before the looking-glass, he will probably return in the course of a few days comparatively well able to display his fauces, and to submit to the needful examination.

By one or other of the methods already indicated (p. 39) the tongue may generally be kept out of the way. If, however, these methods fail, and the tongue still rises so high as to obstruct the view of the soft palate, etc., the patient should be directed to make a few deep inspirations, and alternate them with the repeated pronunciation of the broad vowel "*a*" (ah). He should breathe through the mouth only; not through the nose. In this way the tongue may often be brought into favorable position. Sometimes a broad spatula or tongue depressor may be advantageously used. But as a general rule the introduction of any unnecessary instrument into the mouth should be avoided.

Occasionally by sliding the finger along the tongue (the speculum being at the same time introduced and illuminated), an effort at vomiting is produced, during which the tongue being depressed and the larynx raised, a good though a momentary view may be obtained.

In cases in which *the soft palate is unusually short, and the uvula small and thin*, the speculum is apt to slip up somewhat behind them, and to become partially hidden. Under such circumstances it is better to hold the instrument as nearly as possible in its proper position without touching or resting against the soft palate.

An elongated and thickened uvula may obscure the view by hanging below, and turning round the inferior border of the speculum. The employment of a larger speculum, or a little manœuvring of the instrument, serves to obviate this source of difficulty for the time being; and it may be permanently removed by appropriate measures.

Considerable embarrassment is often caused by *chronic enlargement of the tonsils*. In such cases a narrow, elongated, elliptical speculum should be used, and carried somewhat more deeply into the pharynx than is usually necessary. Enlarged tonsils are often so little sensitive that the speculum may be pushed well in between them without causing much discomfort.

Pendency or projection backwards of the epiglottis is a frequent source of considerable difficulty. Gibb states as the result of his observations that some such abnormal condition is to be found in eleven per cent. of otherwise healthy individuals.[1] It depends upon undue elongation of the glosso-epiglottidean ligaments or folds of mucous membrane, together with relaxation or weakness of the muscular fibres they contain. The degree of obliquity observed varies greatly in different cases, and to some extent in the same case under different conditions. In some instances the epiglottis hangs almost horizontally over the entrance to the larynx; but more frequently its deviation from the normal erect position is comparatively slight, or even only occasional. Laryngoscopic inspection is of necessity proportionately impeded. The greatest difficulty is often experienced in obtaining a satisfactory view, and sometimes even partial success appears to be impossible.

In all cases of pendent epiglottis it is necessary to carry the speculum further backwards and downwards, and to make
its reflecting surface look more fo
than is desirable in the normal co
of parts. Sometimes its lower
must be placed against the posteri
of the pharynx. When the specu
in position, the patient should be di
to utter a series of short, high,
notes, or to imitate a shrill *falsetto*
During the emission of such soun
epiglottis is suddenly raised, and
forwards. Opportunity may be t
forded for a succession of brief gl
of the interior of the larynx, whic
suffice at any rate to determine th
nosis. Another method which som
proves partially successful is as fo
The head of the patient is throw
as far as possible, and his tongue
jected and held by himself. The
lum is introduced and inclined
backwards and downwards, and t
geon having lowered his head loo
it as it were from below upward
the same time with his free ha
presses the pomum Adami of the
backwards and somewhat up
There can be no doubt that the
may often be moved into compar
favorable position for inspection
ternal manipulation; but the met
liable to occasion much discomfo
sometimes considerable pain.

In some instances, in spite of
tempts, the epiglottis still pers
hides the larynx from view. And
cases it may be desirable to raise
chanically by instrumental aid. F
tenaculums, and hooked sounds of
kinds have been devised for this
by Bruns,[2] Voltolini, Fournié,
Mackenzie and others. But all s
struments are difficult for the sur
use, and still more difficult for
tient to tolerate [and are occas
dangerous by direct injury]. It
in very exceptional cases that they
employed with advantage. The
tis is extremely sensitive; but i
firm pressure and a steady but gen
better than the uncertain titillatio
hesitating touch. If any atte
seizure be made, the instrument
be carefully warmed previous to in
tion.

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[1] Op. cit., p. 44.

[1] See Krishaber. Op. cit., p. 493.

[2] Bruns appears to have been the
have used an instrument of this kind;
did so in the case of his own broth
suffered from a polypoid growth in the
The epiglottis was elevated by means o
of flat-bladed forceps, and the grow
successfully removed. See Die erste
tung eines Polypen in der Kehlkop
Dr. Bruns. Tubingen, 1862. A
Laryngoskopie. Dr. Bruns. Tubinge
p. 257.

Difficulties arising from unusual sensitiveness of the uvula and soft palate may generally be overcome by patience and dexterity on the part of the surgeon, and a little practice on the part of the patient. During the earlier attempts the speculum should not be maintained too long in contact with the parts. It should be at once withdrawn if decided retching is produced; and short of such effect, if the irritability is great, it is better to apply the speculum repeatedly for a moment or two, and remove it as often, without caring to obtain any view until the parts have become as it were accustomed to the presence of the instrument. When once efforts at vomiting have been excited, there is little probability of success until a future occasion. Preparatory measures of various kinds have been from time to time suggested; some of these are probably useful; others have been proved by experience to be altogether useless. Many owe their accredited efficacy to the confidence with which their exhibition has inspired the patient. The internal administration of bromide of ammonium or bromide of potassium in full doses has been strongly recommended and extensively tried, but with variable results. Gargles containing bromide of ammonium are said by Gibb to produce "moderate anæsthesia" of the fauces in twenty-four hours.[1] Türck reports favorably of the repeated application to the fauces of a mixture (recommended by Bernatzik) which consists of three grains of hydrochlorate of morphia, one drachm of alcohol, and half an ounce of chloroform.[2] But all such applications as this would appear more likely to inflame than to soothe the sensitive parts. Alum gargles, or solutions of alum or some other astringent in the form of spray, are often useful. Occasionally a few whiffs of chloroform may be advantageously inhaled. But by far the best and easiest plan, so far as I know, is to direct the patient to suck a little ice immediately before submitting his throat for examination. The result is generally satisfactory.

[Dr. Rossbach has recently recommended local refrigeration for two or three minutes, by ether-spray or the like, of the superior laryngeal nerve, where it lies subcutaneously over the thyro-hyoid membrane, just at its point of penetration of that structure. Some experiments, instituted at the writer's public clinic, have sustained the observations of Dr. Rossbach in a number of instances, although the plan has sometimes failed utterly.]

Besides the various sources of difficulty thus discussed, there are others which depend upon inexperience and want of dexterity on the part of the surgeon. These can only be obviated by careful practice. The surgeon should not only familiarize himself with the management of the laryngoscope, but also with the relations and appearances presented by the healthy living parts when viewed by its aid. In color especially, the mucous membrane of the larynx seen during life in the laryngeal mirror looks very different to what it does when examined after death on the *post-mortem* table. It is very possible for the tyro in laryngoscopy to mistake the natural tint of some parts for a certain degree of inflammatory redness.

The general appearances and relations of parts as seen in the laryngeal speculum need no special description. They may be learnt by the careful study of a larynx removed from the body, or by *auto-laryngoscopy*, or by the examination of the larynx of some living subject. But with regard to the color presented by the different parts in a state of health, the following observations may be made.

The lingual surface of the epiglottis appears of a yellowish or pinkish drab color. Its upper border is decidedly yellow. Its laryngeal surface, especially the "cushion," varies from a pinkish yellow to a deep pink; sometimes it appears bright red—so bright, indeed, as to suggest the idea of the existence of an inflammatory condition. The aryteno-epiglottidean folds are pale pink. Stoërk accurately describes them as being about the same color as the gums. The mucous membrane covering the arytenoid cartilages is still pink, but of a somewhat deeper tint. The false vocal cords are perhaps slightly deeper pink still. The true vocal cords are distinguished by their glistening pearly whiteness; but sometimes they are slightly grayish. The cricoid cartilage is recognized by its well marked yellowness. The tracheal cartilages appear of a yellowish drab color; and between them the mucous membrane is pale pink.

A great variety of different instruments have been devised from time to time for the several purposes of demonstrating to others the appearances of the larynx under examination; of holding the laryngeal mirror in a position so as to leave both hands of the surgeon free; and of depressing the tongue at the same time the laryngeal mirror is introduced. Some of these are useful; others are rendered unnecessary by the aid of a skilful assistant. For descriptions of all such contrivances reference may be made to the special treatises already quoted.

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[1] The Laryngoscope in Throat Diseases. Op. cit. p. 46.

[2] Allgem. Wiener Med. Zeit., p. 98. 1833.

General Remarks on the Treatment of Diseases of the Larynx.

The laryngoscope affords most valuable aid, not only in the diagnosis, but also in the treatment of the various diseases of the larynx. Guided by the view obtained, the surgeon is enabled to make such local applications as may seem desirable, with accuracy and precision, and to perform many different operations—such as scarifying the mucous membrane, opening abscesses, removing growths, etc., with certainty and safety. The use of the laryngoscope has altogether set at rest the doubts formerly entertained as to the practicability of introducing brushes, probangs, and other instruments into the larynx.[1] Such doubts have in past time unquestionably prevented the adoption of methods of treatment, that in many cases, might have been eminently successful. But nowadays it would appear that the danger is in the opposite direction, and that the tendency is rather to carry out local treatment too vigorously, or to rely upon it too exclusively.

Remedial applications may be made to particular parts, or to the whole of the interior of the larynx with variable advantage by several different methods. It appears desirable to give at once a general description of such methods, and to refer in the succeeding sections to the special modifications requisite in the treatment of each particular malady.

Solid substances may be applied either in the mass or in powder. If applied in the mass, some form of caustic holder is requisite. No instrument answers so well, and at the same time is so safe, as a piece of moderately thick aluminium or silver wire mounted in a slender handle, and hollowed into a tiny cup, or roughened at the extremity. The roughened extremity may be dipped into various substances, as nitrate of silver, chloride of zinc, etc., while in a state of fusion; and a sufficient quantity may be taken up in a bead-like form, or as a thin coating. The wire may be easily bent at any angle requisite, and there is no danger of any considerable portion of the substance breaking off and falling upon parts it was not intended to reach. Such danger might arise during the use of some of the various complicated caustic holders that have been devised for similar purposes. By aid of the laryngoscope a small caustic bead, prepared in the manner described, may be definitely applied to any particular point; or if the wire is coated to a sufficient extent, the general surface may be wiped over.

Powders can only be applied to the mucous membrane generally. They may be inhaled through a tube, as recommended by Fournié, or, far better, blown in by means of Rauchfuss's insufflator[1], or some modification of it. The insufflator, duly charged, is introduced into the back of the fauces, with the extremity turned down towards the larynx. The patient is then directed to make a slow steady inspiration, and while he is doing so the India-rubber ball of the insufflator is suddenly compressed. Under such circumstances it is obvious that a considerable portion of the powder must be diffused over the mucous membrane of the larynx. The powders that have been used with most advantage in this manner are tannic acid, alum, acetate of lead, sulphate of zinc, sulphate of iron, calomel, and in some exceptional instances, nitrate of silver. It is scarcely needful to add that in every case the substance used should be very finely pulverized. Sometimes it may be advantageously diluted with two or three or more parts of sugar of milk.[2]

Liquids, or substances in solution, may either be applied by means of a full-bellied camel's-hair brush, or small sponge, mounted on a properly curved aluminium or silver wire or whalebone stem; or they may be injected in a fine shower from Gibb's "laryngeal syringe" or "hand atomizer;"[3] or they may be inhaled in the form of "spray," produced by one or other of the various instruments devised for the purpose. Strong solutions, especially those of a more or less caustic nature, should, as a rule, be applied by the brush. Among the more generally usefu of such solutions may be enumerated those of nitrate of silver (℈ij or ʒij to ℥j of distilled water), perchloride of iron (ʒij o more of the tincture to ℥j), pure carbolic acid (ʒss or more to ℥j), alum (a saturated or weaker solution), sulphate of copper (saturated or weaker solution), etc. Glycerine or honey may be advantageously mixed with these solutions in considerable proportion, in order to give them viscidity, and render them more adhesive Iodine (gr. xx), iodide of potassium (gr v), and olive oil (℥j), forms an applicatio recommended by Dr. Marcet.[4] The "gly cerinum acidi tannici" (B. P.) may also be used in some cases. By means of the brush all such substances may be applied with a certain degree of precision to any particular part. In some instances even nitric acid, chromic acid, and other powerful escharotics have been thus applied to ulcers, warty growths, etc., with safety and advantage. At the moment the brush is to be introduced into the larynx, the patient should be directed to make a full deep inspiration in order to dilate the aperture as widely as possible. In cases in which the epiglottis is pendent, it is often very difficult to get the brush beyond it into the larynx. Under such circumstances the laryngeal syringe may be more successfully used, inasmuch as its extremity may be guided round, and made to raise the pendent valve to a sufficient extent.

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[1] See the first edition of this work, vol. iii., pp. 246 and 247, note.

[1] This instrument is figured in the Essay o Diseases of the Nose, vol. ii., p. 238.

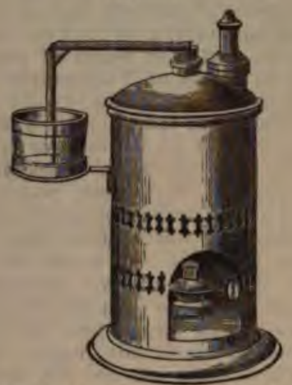
[2] Studley, American Medical Times, Marc 2, 1861.

[3] See The Laryngoscope in Diseases of th Throat, by Sir G. D. Gibb, M.D., p. 92.

[4] On Diseases of the Larynx, by W. Ma cet, M.D., p. 18. 1869.

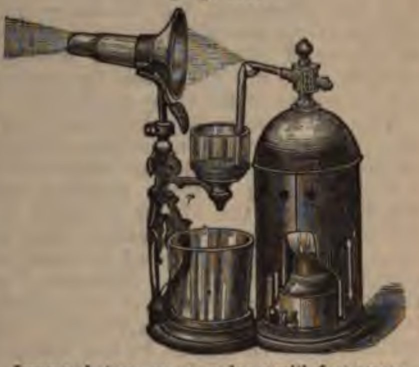
The inhalation of "atomized fluids," or spray, in the treatment of diseases of the air-passages, though suggested long previously, was first shown to be generally practicable by Sales-Giron in the year 1858.[1] Since then the great value of this method has been fully established, and various improvements have been from time to time effected in the apparatus employed.[2] The "spray-producers" at present in ordinary use, consist of two tubes (Bergson's tubes) fixed at right angles to one another; of these, one, placed horizontally, is connected at its distal extremity with some apparatus by means of which a strong current of air or steam can be continuously projected through it; and the other, placed vertically, dips into a bottle or other small vessel containing the medicated fluid. The proximal extremity of each tube is terminated by a very fine orifice; and the orifice of the former tube is immediately over that of the latter. When a current of air or steam is made to rush forcibly from the orifice of the one tube over that of the other, it causes the medicated fluid to rise, and breaks it up as it issues, and diffuses it in an exquisitely fine spray. In Dr. Andrew Clark's well-known instrument (as well as in the various modifications of it adopted by different makers), air is employed, and the current is kept up by means of an India-rubber "handball" bellows. All such instruments, however, though unquestionably useful, are far inferior, for several obvious reasons, to those in which a jet of steam is employed, as first suggested by Dr. Siegle, of Stuttgart. The steam is derived from water contained in a small boiler heated by a spirit-lamp. Figs. 558 and 559 represent two very efficient modifications of Dr. Siegle's original pattern.[1]

Fig. 558.



Da Costa's steam spray-producer.

[Fig. 559.



Improved steam spray-producer with face screen attached.

The use of this instrument involves no continuous exertion like the handball spray-producers: and what is of far more importance, the atomized fluid is mixed with and propelled by a current of warm steam instead of cold air. A great variety of different solutions, the strength being varied according to circumstances, may be advantageously inhaled in the form of spray. Among them may be especially mentioned the following—the medicament being in each case in about the proportions specified to an ounce of water:—Alum (gr. x to gr. xx), tannic acid (gr. j to gr. xx), perchloride of iron (gr. ⅛ to gr. ij, or of the tincture ♏ x to ♏ xxv), as "astringents;" common salt or chloride of ammonium (gr. x to gr. xxx), chlorate of potash, borax, or iodide of potassium (gr. iij to gr. x), as "alteratives;" and watery extract of opium (gr. ¼ to gr. ½), hydrochlorate of morphia (gr. ⅛ to gr. ⅓), or fluid extract of hemlock or hyoscyamus (♏ iij to ♏ x), as "sedatives" or "anodynes." Very weak watery solutions of iodine, and chlorine (or chlorinated soda), tar water, lime water, weak alkaline solutions, sea water, the saline waters of many mineral springs,[1] and other solutions too numerous to mention have also been largely used in different cases with variable advantage. Sulphurous acid in spray has recently been very strongly recommended in the treatment of various affections of the throat and larynx by Dr. Dewar and others. But experience seems to show that great caution is requisite in the use of this material. Though doubtless beneficial in some cases, in many it has proved not only less efficacious, but far more mischievous than was anticipated. Solutions of nitrate of silver and other powerful metallic salts are unsuitable for application by means of the spray-producer.

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[1] See the elaborate report by Poggiale read before the Académie de Médecine, Paris, January 7, 1863, and the discussion thereon. Also Dr. Beigel's treatise on Inhalation, London, 1866, in which are full details as to the history of this method of treatment, and descriptions of the different forms of apparatus devised.

[2] Mackenzie especially recommends Mayer's modification of Matthieu's apparatus, which is worked by means of a pressure-pump; and acts on a different principle to that described above. The fluid is forced through a fine orifice and projected against the interior of a vulcanite drum. It thus becomes broken up into a fine spray. Op. cit., p. 90.

[1] These as well as other forms of this apparatus are made by almost all instrument makers.

Many substances may be inhaled with very great advantage in the form of vapor or gas. In various acute or subacute affections nothing is more soothing and beneficial than the almost constant inhalation of warm steam, either plain or charged with some narcotic or anodyne element. The "hemlock inhalation" of the British Pharmacopœia is very useful; it is rendered less disagreeable and perhaps more efficacious by the addition of a pinch or two of fresh dried hops; or the hops may be infused alone in the hot water; or a portion of opium may be added; in some cases vinegar is useful and pleasant. In chronic cases, according to their nature, the vapor o
pentine, or some aromatic terebintl
or iodine, or calomel may be inhale
very great benefit. For the inhala
steam, plain or medicated, vario
called "inhalers" have been de
Among those ordinarily used m
mentioned Nelson's, Maw's "d
valved inhaler," Mudge's, and B
made by Robbins. The two first
are furnished with pieces of
which are intended to be imbue
the medicament to be used; but
cally it is far better to remove the s
and to mix the medicament with t
water. The two last inhalers i
somewhat more respiratory exert
the part of the patient. But the
the advantage of acting on the "ho
principle; the air to be inspired
through the fluid, and thus b
thoroughly warmed and charged w
por. But by far the most perfect
yet devised is that made by Messr
under the direction of Dr. Macl
and by him termed the "Eclec
haler." The advantages of this
ratus are so obvious that it will pr
to a great extent supersede those
to in use. Bird's inhaling pipe is
of mention, as likely to prove ve
ful for the exhibition of certain
etc.[1]

Scarification of the mucous me
of the larynx may be practised wit
siderable advantage in many cases
instruments requisite and the met
operating have already been descri
the first volume of this work (p
In all cases, if practicable, the
ment (which must be very sharp)
be guided by aid of the laryng
Mackenzie's laryngeal lancet answ
purpose admirably; but it is som
complicated, and is not so likely t
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ent parts. There is very rarely
bleeding, and never, so far as I kno
more than is actually beneficial.

The direct galvanization of the
cords is strongly recommended in
nervo-muscular affections of the
The most efficient apparatus fo
purpose is the laryngeal galvani
Mackenzie. One pole of the bat
connected with a properly curved
wire terminated by a small wetted
which is placed in contact with th
cous membrane of the larynx. Th
pole is connected with a handle be
sponge which is applied to the f
the neck. When the two parts of

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[1] In 1849 Auphan, of Euzet-les-Bains, originated the idea of atomizing the mineral water by throwing a jet of the liquid against the wall of the inhalatory. After a short time the same system was adopted in Lamote-les-Bains. But Sales-Giron first constructed at Pierrefonds an apparatus through which the fluid was subdivided into a fine mist, which was inhaled by the patients with great benefit.—Beigel, op. cit., p. 6. At many of the Continental Spas arrangements are now made for the inhalation of the atomized waters.

[1] Made by Maw. See Med. Times an
vol. i., 1869, p. 672.

strument are in position, the circuit is completed by pressing upon a small trigger on the handle of the laryngeal portion of the galvanizer. The galvanizer may be applied several times at the same sitting, it being kept in for a few seconds each time.[1] Other instruments have been devised with similar intent, but the one described appears to have found most favor with practical laryngoscopists. It is recommended by George Johnson, Smyly, Fauvet, Tobold, Marcet, Gibb, and others.

CATARRHAL LARYNGITIS.

Acute Catarrhal Laryngitis is a formidable, and not very rare affection. It varies greatly in intensity, and consequently in the degree of danger to which it gives rise. It may occur at almost any period of life, but is most frequently met with in adults of plethoric habit.

Exposure to cold and damp, especially after prolonged exertion of the voice, and when the general powers are reduced by fatigue, is the most common cause.

As a rule the fauces are first affected, and the inflammation spreads with variable rapidity to the larynx. Sometimes, however, the malady commences in the larynx itself, and is confined to it.

The earliest *symptoms* are those of an ordinary "sore throat." The patient complains of dryness, soreness, and a sense of constriction about the upper part of the throat, together with tenderness on pressure over the larynx, and pain and difficulty in swallowing. The feeling of discomfort is constantly referred to the pomum Adami, or its immediate neighborhood. Respiration soon becomes impeded; the patient experiences a sense of oppression, and from time to time feels it needful to make an effort to breathe deeply. His voice becomes thick and husky; and occasionally he tries as it were to "clear his throat" by a dry, harsh, or half suppressed and painful cough. Accompanying these symptoms there is more or less general febrile disturbance.

As the malady advances, the symptoms increase in severity; and the patient becomes restless and anxious. The face is flushed, the skin hot and dry, the pulse hard and quick. Respiration becomes more and more seriously impeded. Inspiration is difficult, protracted, and painful, and is accompanied by a wheezing, whistling, or harsh throttling sound. The chest is not fully expanded; and there is diminution of the respiratory murmur. Expiration remains comparatively easy; for the warm, moist air from the lungs irritates the inflamed and sensitive mucous membrane much less than the colder, drier air, inspired from without. The dyspnœa is constant in so far as it depends upon constriction of the glottis from swelling of the mucous membrane; but it becomes greatly aggravated at intervals in consequence of spasmodic action of the muscles. The voice, at first husky and hoarse, soon becomes low in tone, or "cracked" and uncertain, and finally is altogether lost, the patient speaking only in a whisper. In some cases there is but little cough. In others the cough is frequent, and harsh, husky, or stridulous in character. Cough may be provoked either during inspiration by the contact of cold dry air, or during expiration by the presence of little masses of secretion. The sputa in the earliest stages are very scanty, and consist of little more than saliva; later they become somewhat more abundant, but are still semitranslucent, though more or less tenacious and viscid, containing laryngeal mucus as well as saliva; still later they are opaque and grayish, and sometimes are slightly streaked with blood. After any of these have been coughed up a painful sense of rawness about the part is often experienced. The small, firm, agglutinated masses which are occasionally coughed up, probably come, according to Krishaber, from the ventricles of Morgagni. The difficulty of swallowing, almost invariably noticed as one of the earliest symptoms, becomes more and more pronounced as the malady progresses. "*Difficulty of deglutition* for which no adequate cause is visible in the fauces," speedily followed by "*difficulty of breathing* for which no adequate cause can be discovered in the thorax," are, in the words of Sir Thomas Watson, "among the earliest of the symptoms that bespeak danger, and ought to excite alarm."[1]

If the malady advances to the next stage, and no relief is afforded, the general distress of the patient becomes intense. He labors and struggles for breath. His anxiety and restlessness are extreme. He cannot lie down; or if, exhausted, he tries to do so, he soon starts up involuntarily, gasping for very life. His countenance becomes pale and livid, or even ghastly; his eyes protrude; sweat pours from his forehead; his skin is cold and clammy; his pulse becomes weak and intermittent; exhaustion, drowsiness, and perhaps delirium supervene; and lastly, he dies suffocated—either almost suddenly from spasm of the larynx, or by a process of comparatively slow asphyxiation.

The morbid changes which give rise to the symptoms thus described may be

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See Mackenzie. Op. cit., p. 96.

[1] Lectures on the Principles and Practice of Medicine. 4th edit., vol. i., p. 831.

traced during life by aid of the laryngoscope, or made out after death on post-mortem examination.

On *laryngoscopical inspection* the mucous membrane of the larynx is seen to be of an unnatural scarlet red color, and more or less thickened or swollen. Occasionally superficial erosions may be recognized here and there; but neither deep nor extensive ulceration is observed, or only extremely rarely. The redness and swelling, as a rule, are especially manifest in those parts in which the mucous membrane is thick, and is supported by abundant loose submucous areolar tissue. Thus the aryteno-epiglottidean folds, the mucous membrane of the vestibule, the false vocal cords, and the laryngeal aspect of the epiglottis present these appearances in the most marked degree; and generally speaking, they are affected in extent in the order in which they are named. The mucous membrane of the true vocal cords, on the other hand, being comparatively thin, and closely connected with dense subjacent tissues, is less swollen, and less uniformly reddened. Sometimes it is marked by red striæ or patches. Sometimes it seems only to have lost its pearly whiteness, and to have become dull, clouded, or pinkish in color, and somewhat unduly protuberant. But, as may readily be understood, in many cases the true vocal cords are almost or entirely concealed from view by the swollen parts above. Still more is this the case with the parts of the larynx below the glottis, and the trachea, which, nevertheless, not infrequently suffer from extension of the inflammation. The epiglottis is usually seen to be erect, rigid, and swollen. It is consequently unfitted to fulfil its natural valvular office. Sometimes it may be felt by the finger as a smooth, rounded, "cherry-like" intumescence. Occasionally it gives rise to sensations similar to those produced by the presence of a foreign body. The patient "feels as though he had something in his throat."

The condition of the epiglottis serves in great measure to explain the difficulty in swallowing, and the sense of suffocation often experienced when the attempt is made. The dysphagia is still further accounted for by the pain caused by the necessary movement of the inflamed and unduly sensitive parts.

The swollen condition of the mucous membrane and consequent constriction of the glottis manifestly give rise to the constant difficulty of breathing; and the temporary paroxysms of extreme dyspnœa are caused by muscular spasm incidentally or accidentally excited.

Post-mortem examination shows that the swelling depends upon an injected, infiltrated, and œdematous condition
mucous membrane and submuco
sue. The redness of the parts ob
during life is often partially or
lost—inasmuch as the mucous mem
shares in the general pallor of
Soft, semipurulent, or viscous exu
is usually found covering to some
the membrane. In some cases the t
and bronchi are also affected; a
lungs are congested, or even pneu

The *diagnosis* of acute catarrhal
gitis is not difficult. It may be
guished from croup and diphtheria
absence of the false membrane
fibrinous exudations which chara
these maladies; and from croup es
ly by the difficulty in swallowing, a
early alteration or extinction of the
In croup swallowing is usually eas
voice is often but little affected
breathing is "stridulous," and the
has a peculiar ringing "brassy" so

Laryngitis may be distinguished
the first effects of a foreign body
air passages by the sudden severit
which in the latter case the dy
comes on, the periods of interm
which occur, and the absence of pr
tory febrile disturbance. The dif
of breathing caused by the presenc
foreign body is usually most marke
ing expiration. The reverse is th
in laryngitis.[2]

In cynanche tonsillaris respiratio
ten obstructed. But the cause of o
tion is at once manifest on inspecti
fauces. In laryngitis, on the other
the amount of swelling in the upp
of the throat (if even any exists) i
gether insufficient to account for t
treme difficulty of breathing and sw
ing, and the alteration or extinct
the voice. It must be borne in
however, that laryngitis, or at a
œdema of the larynx, may coexis
inflammation of the tonsils and
membrane of the fauces and phary

In simple pharyngitis there is l
no dyspnœa; but swallowing is
and difficult, and pain is felt wh
larynx is pressed backwards.

The *course* of acute catarrhal lar
is usually rapid. Its duration d
upon the intensity of the inflamm
the constitution of the patient, a
nature and efficacy of the tre
adopted. If unchecked it often
fatal on the fourth or fifth day, and
times much more speedily. Th
brated General Washington died
disease within twenty-four hours

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[1] See the article on Croup and Diph

[2] See chapter on Foreign Bodies in
Passages. Vol. i., p. 705.

Thomas Watson alludes to an instance in which a fatal result ensued in twelve hours.[1]

Mr. Gray mentions the case of a man who was "admitted into St. George's Hospital complaining merely of sore throat. He walked into the hospital, and seemed in such good health that he would not have been admitted, but for the circumstance of his having come some distance from the country. About three hours after his admission, the house surgeon was summoned in all haste to see him, as he was said to be dying of suffocation. He went immediately, but found the patient quite dead. Post-mortem examination revealed all the evidences of laryngitis, supervening apparently upon inflammation of the pharynx; but it was especially remarked, that the chink of the glottis was not much narrowed from œdema. In this case there can be no doubt that death was produced by spasmodic contraction of the muscles of the glottis.[2]

In some instances, however, the malady runs a less rapid course, and the patient survives until the eighth or ninth day. In others, and these happily not a few, the inflammation subsides either spontaneously, or as the result of treatment. In such cases the effects may disappear almost altogether with comparative rapidity, or the malady may assume a chronic form.

Treatment.—The treatment requisite depends upon the severity of the malady, and the stage it may have reached. Measures which are urgently demanded in some cases are in others unnecessary, and even dangerous. And the mode of treatment that might be most efficacious at the onset of the malady, if adopted too late, may only hasten the fatal termination.

In the earlier stages, and in cases in which the symptoms are comparatively mild, perfect quiet in a warm moist atmosphere [pellets of ice allowed to melt in the mouth from time to time; a cold compress over the anterior portion of the neck], soothing inhalations either of simple or medicated steam or spray, and the administration of salines, with perhaps antimonials and tincture of aconite or some sedative, according to circumstances, constitute the treatment requisite. But in all cases careful watching is necessary; for dangerous symptoms may supervene at any time, and even almost suddenly.

In the more severe forms of the malady, similar but more energetic measures must be rigorously enforced. Soothing inhalations may still be advantageously employed, but their use must be more constant. Antimony and tincture of aconite in small but frequently repeated doses should be administered, especially in cases in which there is much general inflammatory fever.[1] Free mercurialization has been strongly advocated, but its efficacy appears doubtful; and much precious time may be lost before the system can be affected. General bloodletting, so highly lauded in past times in the treatment of this disease, may be resorted to in the earlier stages. But satisfactory evidence in favor of this proceeding is altogether wanting. Sir Thomas Watson says:—

> "When there is high inflammatory fever present, and the skin is hot, and the pulse firm and full, and the cheeks red, and the lips florid, you may bleed your patient with decision and advantage. But if his powers are beginning to sink under the poisonous influence of imperfectly aërated blood, if his skin be cold or even cool, his face pale or leaden, his lips blue, his pulse small and feeble, his mind wavering, you will do no good by bloodletting: nay, you will increase the debility which already exists, and hasten the fatal catastrophe."[2]

The instances, however, which Sir T. Watson quotes, tell as much against, as in favor of general bloodletting. And indeed it would appear that more air in the lungs is required, rather than less blood in the system. Local bloodletting by means of leeches to the neck or upper part of the chest, or cupping to the nape of the neck, may sometimes prove beneficial. So also may blisters or milder counter-irritants; but these should not be applied immediately over the larynx.

When the mucous membrane is so swollen as to impede respiration and swallowing to a serious extent, scarification by means of a sharp-pointed guarded bistoury, or some specially designed instrument, is often followed by speedy relief.

A somewhat remarkable case illustrating the effects of this method of treatment came under my observation in December, 1866. A gentleman residing in Essex, fancying he heard poachers in the neighborhood, got up in the middle of the night, went out carelessly dressed, and concealed himself for two or three hours in a ditch. The next morning he was seized with all the symptoms of intense laryngitis; and he died suffocated within eighteen

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Op. cit., vol. i., p. 833.

See the first edition of this work. Vol. ii., p. 226.

[1] The following formula may be recommended:—Vin. antim. tart. ♏ ij to ♏ iij, tinct. aconiti ♏ j to ♏ ij, liq. ammon. acetat. ʒss; to be taken in water or camphor julep every quarter of an hour or every half-hour, until some obvious effect on the circulation, etc., is produced, and then to be continued less frequently.

[2] Op. cit., p. 835.

hours. Three days afterwards the brother of this gentleman, depressed in spirits, and fatigued, and almost exhausted, was exposed for some time to cold and wet. In the evening he was attacked by symptoms similar to those from which his brother had suffered. The next morning I saw him in consultation with his medical attendant, Mr. Jordison, of South Ockenden. The soft palate, uvula, and pillars of the fauces were acutely inflamed, and very much swollen and œdematous. The epiglottis and aryteno-epiglottidean folds were in a similar condition. The patient's suffering was extreme; breathing was carried on with great difficulty; swallowing was impossible. I at once freely scarified the affected parts by a number of punctures and small incisions, and caused the patient to inhale the steam of hot water. A considerable quantity of serous or seropurulent exudation with some blood was discharged. In the course of half an hour the breathing was much relieved, and swallowing was accomplished without any great difficulty. The swelling of the parts rapidly subsided, and the next day, when I saw him again, the patient could breathe and swallow with comparative ease—indeed, almost naturally—but he still suffered from considerable general distress, and symptoms of pericarditis were recognized. Death took place twelve hours after my visit, or about sixty hours from the commencement of the attack. Post-mortem examination revealed the most intense inflammation of the whole pericardium I have ever seen. But the extent to which the faucial and laryngeal mucous membranes had recovered their natural condition and appearance was very remarkable.

Sir G. D. Gibb (following Dr. Horace Green) strongly advocates the application of a solution of nitrate of silver (three or four scruples to an ounce of water) in cases of acute laryngitis. The application may be made by means of a full bellied camel's-hair brush on a curved aluminium wire stem, or by "the laryngeal fluid pulverizer." "The effect of this proceeding is some considerable amount of burning heat, associated with comparatively little spasm, and sometimes dyspnœa, the last two persisting for may be a few seconds only. . . . The relief experienced, and the amelioration in the general symptoms, is observed in periods ranging from half an hour to four hours, and the dyspnœa subsides very speedily."[1]

If, as too often happens, the malady advances in spite of all such measures as those above suggested, or if the difficulty of breathing is too urgent to admit of their adoption, tracheotomy must be at once performed. In no class of cases probably is the value of tracheotomy as a life-saving operation more obvious and more pronounced. No definite rule can be laid down as to the period at which it may be desirable to operate. The surgeon must decide in each case when the proper moment has arrived, and must not hesitate to urge in the strongest terms the importance of every minute. There is far greater danger in delaying the operation too long, than in performing it unnecessarily early. The operation itself, if properly performed, is attended by little or no risk.[1] But it affords immediate relief from the direst suffering. It obviates altogether the recurrence of those frightful paroxysms of dyspnœa, in any one of which the patient may die suffocated. It affords perfect repose to the suffering parts, and saves them from the irritation of the hard-drawn breath. It thus allows opportunity for the subsidence of inflammatory action, and the absorption of effused material. It may not *cure*, but if performed in time, it certainly ensures a period of safety and freedom from distress, during which the cure may be effected by natural processes.[2] Further, in acute laryngitis the obstruction to respiration is, as a rule, confined to the larynx itself, and the parts below are rarely affected to any serious extent: the malady runs a rapid course, and under favorable circumstances subsides almost as quickly as it arises. Hence, not only is immediate relief almost absolutely certain, but there is little probability that the canula need be retained longer than a few days at the outside. While fully impressed with the danger of delay, the surgeon must nevertheless bear in mind that until the patient is actually dead it can never be too late to attempt the operation. And even if it should seem that the last breath has just been drawn, the operation should still be completed, and persevering efforts made to restore life by artificial respiration. Success has crowned such efforts in cases in which the general powers have not been too far exhausted by slow asphyxiation. [In the editor's practice he has restored respiration by insufflation through a catheter passed into an artificial opening into the trachea, made fully four minutes after apparent death. Other similar rescues have been reported.]

Chronic Catarrhal Laryngitis rarely occurs except as the result of one or more attacks of acute or subacute inflammation.

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[1] On Diseases of the Throat and Windpipe, by G. D. Gibb, M.D., 2d edition, p. 196.

[1] See an essay by the present author: On Some of the Difficulties and Dangers of Tracheotomy, in the Practitioner, April, 1869.

[2] Out of 49 cases of tracheotomy for acute laryngitis of this kind which have come under my observation, or of which I have collected particulars, life was saved in 30, and death ensued in 19. In many of the fatal cases the operation was obviously performed too late; hence the result.

As such, however, it is a comparatively common affection. In this respect it differs remarkably from "Chronic Glandular Laryngitis" or "Follicular Disease of the Larynx," which, as a rule, is not preceded by any acute inflammatory symptoms, but on the contrary is chronic in character throughout its whole course.

Chronic catarrhal laryngitis is much more frequently met with among adult males than among females or children. This is due in great measure, no doubt, to the more constant exposure to vicissitudes of weather to which men are subject, as well as to the greater demands made upon their respiratory and vocal organs from the nature of their occupations. It often results in cases in which the acute symptoms have not been very severe ; or in which they have subsided so far as to permit the patients to resume, without immediate inconvenience, their usual habits before the actual structural lesions have been sufficiently repaired. Hence the necessity for continued rest, watchfulness, and judicious treatment during convalescence from acute catarrhal laryngitis, even though the symptoms may have been comparatively mild. It need scarcely be remarked that when once the chronic affection is established, and so long as it continues, the patient is especially liable to a recurrence of acute attacks, any one of which may be fraught with danger.

The *symptoms* of chronic catarrhal laryngitis are:—hoarseness, want of tone, or some other unnatural condition of the voice; a sense of effort during speaking (especially if at all prolonged), and of fatigue afterwards; frequent desire "to clear the throat;" and more or less frequent cough, accompanied by occasional but scanty expectoration of thick, grayish, opaque, or semipurulent mucus. A general sense of discomfort is sometimes experienced, but there is no pain in the part; nor is there any marked tenderness on pressure. Tranquil respiration is, as a rule, performed easily, and without the characteristic whistling or throttling sound emitted during inspiration in acute laryngitis. Forced respiration, however, is sometimes accompanied by unnatural sounds, which may be readily heard by means of a stethoscope placed over the larynx or trachea. The cough is no longer "tearing" and painful, nor harsh, ringing, and "brassy" as in the acute stages: though often hoarse, and somewhat sonorous, it is not distressing, and suffocative paroxysms very rarely if ever occur. Deglutition is easy and painless.

Thus it would appear that there is nothing absolutely distinctive in the symptoms of chronic catarrhal laryngitis; for very similar symptoms are associated with other totally different conditions to be hereafter discussed. Nevertheless, it is very important that a correct diagnosis should be made, inasmuch as the treatment requisite, as well as the probable issue, may differ very materially from what would be indicated in at any rate some of the other affections alluded to.

On *laryngoscopical inspection* the mucous membrane of the larynx is seen to be thickened and unnaturally red, and covered here and there by patches of grayish opaque mucus. The thickening and redness may be either more or less uniform, or irregular and much more pronounced in some parts than in others. In order of frequency the posterior aspect of the epiglottis, the aryteno-epiglottidean folds, the inter-arytenoid fold, the anterior aspect of the epiglottis, the false vocal cords, and the true vocal cords, are the parts usually affected. In general terms, the acute inflammatory attack is most frequently followed by chronic after-effects in those parts which are naturally most vascular, and most abundantly supplied with glandular structures. Ulcers are very rarely seen, but sometimes small superficial cicatrix-like patches may be observed; and occasionally even a dilated bloodvessel or two may be noticed ramifying in the mucous membrane.

The alteration of the voice does not bear any definite relation to the extent to which the true vocal cords are affected. There may be considerable hoarseness, or partial or even complete loss of voice, in cases in which the vocal cords themselves are found on examination to be almost or altogether healthy in appearance. In such cases the explanation may be due either to the swollen condition of the neighboring parts, which may mechanically prevent the due approximation and tension of the true vocal cords, or may deaden or modify the sound produced by their vibration; or it may be that the surrounding infiltration, or some other effect of the inflammatory process, may hamper or otherwise interfere with the necessary action of the muscles. Whatever may be the explanation in any particular case, laryngoscopy has amply proved (contrary to what was formerly supposed) that the voice may be more or less obviously altered in character, or impaired in power, although the true vocal cords retain their integrity and healthy appearance. The converse is also true. The vocal cords may be visibly affected to some extent in various different ways, as hereafter indicated, without any very serious detriment to the speaking, if not to the singing voice.

The *course and duration* of chronic catarrhal laryngitis vary greatly in different cases. Sometimes it subsides spontaneously in the course of two or three weeks or more. Sometimes, especially if neglected, it remains obstinately persistent; and more or less permanent thickening or hypertrophy (so called) of the mucous membrane results. As a general rule, however, it is amenable to treatment. In some cases of long standing, warty growths become developed. In others tracheal, bronchial, or pulmonary complications arise. In all cases there is great liability to fresh attacks of acute or subacute inflammation.

Treatment.—The treatment most likely to prove successful in simple catarrhal laryngitis, which has become chronic in character, depends somewhat upon the stage the malady may have reached, and the severity of the symptoms. It rarely happens, however, that any other than local measures are requisite, or indeed beneficial, except in so far as they may tend to the improvement of the general health and strength. But in all cases it is desirable, and in some absolutely necessary, to insist upon the importance of affording to the suffering parts as much rest, and as little excitement and irritation, as may be practicable. All unnecessary exertions of the vocal and respiratory organs must for a time be avoided. The most complete rest possible can only be ensured by tracheotomy: and sometimes resort to this operation may be advisable even in the absence of any very acute symptoms. [The writer of these notes is unable to endorse the foregoing recommendation of tracheotomy in this affection, unless it be demanded by urgent dyspnœa threatening suffocation.]

In the earlier stages, the warm soothing vapor inhalations, so beneficial during the period of acute inflammation, must be replaced by more or less frequently repeated applications of astringent solutions, either in the form of spray or by the brush. In a large proportion of cases the inhalation of the spray of weak solutions of alum, tannic acid, [sulphate of zinc, sulpho-carbolate of zinc], or perchloride of iron, or chloride of zinc four or five times a day—or even of common salt, chloride of ammonium, or chlorate of potash—is all that is necessary. Sometimes, however—and indeed I believe in all cases according to some authorities—it is better to resort at once to the application of a strong solution of nitrate of silver (ʒj to ℥j of water) by means of the brush, or sponge probang

In the more advanced stages, when the affection has become decidedly chronic in character, and all reasonable hope of spontaneous subsidence, or of improvement under milder treatment has passed away, the efficiency of the application of the nitrate of silver solution is most marked. The whole surface of the interior of the larynx may be wiped round with the brush; or by aid of the laryngoscope the application may be limited to those parts only which are especially affected. If the sponge is used, as originally recommended by Dr. Horace Green, precision of application is of course impossible [unless a small fragment of sponge, firmly secured to a proper holder, is employed]; but the spasmodic contraction excited may serve to squeeze from the sponge a considerable quantity of the solution, which may become diffused over the whole surface. But, as before stated, the brush is far preferable to the sponge. The application is easily made in accordance with the directions already given.

The spasmodic distress, sometimes though not always produced, very speedily subsides. The good effects are almost immediately perceptible, but are by no means transient. In some cases the application seems to act almost like a charm; and the voice, which before was painfully hoarse, is rendered at once comparatively natural in tone. The application should be repeated once daily, on alternate days, or less often, according to circumstances, until the cure is complete. At intervals between the applications frequent inhalations of the spray of solutions of common salt, chloride of ammonium, or alum may be recommended. Small blisters may sometimes be advantageously applied over the larynx; or counter-irritation may be kept up by means of the strong tincture of iodine.

In cases of very long standing, and especially in those in which the tracheal and bronchial mucous membranes are also affected by chronic catarrhal inflammation, inhalations of balsamic and terebinthinate vapors often prove very beneficial. Turpentine, tar, the balsams of Tolu, Peru, and Canada, or their alcoholic solutions, gum benzoin or benzoic acid, and other similar substances, may be mixed (singly or in combination) with hot water in an appropriate vessel, and the vapor may be inhaled from time to time. Dr. Symonds recommends that substances of this kind should be mixed with æther or pyro-acetic spirit in a wide-mouthed bottle, from which the inhalation may be made.[1] Another method consists in keeping the atmosphere of the room, in which the patient may be, constantly impregnated with the remedial vapors, either by heating portions of the balsamic substances over a spirit lamp, or by putting them upon hot coals. This method is especially recommended by Trousseau and Pidoux, who state that by its persevering adoption cases of chronic laryngitis have been cured which had not been benefited by interrupted inhalations.[1] The same authors also refer to the good effects sometimes produced by the empyreumatic oil of burning paper ("l'huile de papier"), and recommend the inhalation of the smoke of cigarettes of paper, either plain or imbued with some arsenical or other medicinal solution.[2]

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[1] The following formulæ are given: Æther ℥j, benzoic acid ʒiv, Peruvian balsam ℥ij, mix. 2. Pyro-acetic spirit ℥ss, æther ℥ss, benzoic acid ʒiv, balsam of Peru ℥ij; mix. 3. Æther ℥ss, spirits of turpentine ℥ss, benzoic acid ʒiv; balsam of Tolu ʒij; mix. 4. Æther ʒvj, pyro-acetic acid ʒij; mix. The warmth of the hand is sufficient for volatilizing these mixtures.—Therapeutical Memoranda, by J. A. Symonds, M.D., British Medical Journal, May, 1868, p. 448.

Tar water may be inhaled in the form of spray; so also may weak solutions of chloride of zinc, nitrate of silver, etc. But these saline solutions appear to be less efficacious in cases of the class now under discussion than in those which are more recent, and in which the morbid condition of the mucous membrane is less extensive, and less confirmed in character.

Internal remedies sometimes prove useful, especially such as are indicated in catarrhal affections of the respiratory mucous membranes generally, as for example, decoction of senega with ammonia, the various balsams, chloride of ammonium with tonics, etc.

[The habitual use of cold compresses at night is often very advantageous. It is sometimes advisable to bathe the anterior portion of the neck with dilute spirit of turpentine, or spirit of camphor, before applying the compress.]

Men who are subject to catarrhal and other chronic affections of the larynx should wear their beards; and women should be advised to take due precaution for the protection of their necks, especially when they are exposed to cold, or to vicissitudes of temperature.

Chronic Glandular Laryngitis. Follicular Disease of the Larynx. Dysphonia Clericorum.

Chronic Glandular Laryngitis is a comparatively common affection.[3] It is most frequently, but by no means solely, met with among those who are subject from time to time to continuous exertion of the voice, as clergymen, barristers, singers, and others. It essentially consists in more or less general enlargement and hypertrophy of the glandules and follicles of the laryngeal mucous membrane, the result of an inflammatory condition which usually commences very insidiously, and always progresses very slowly. It is often, but not invariably, associated with a similar affection of the faucial, nasopharyngeal, and pharyngeal mucous membranes.

The most frequent cause probably is, as already indicated, continuous exertion of the voice. It is obvious that in prolonged speaking, reading, or singing, the demands made upon the vocal organs are not only greater than during ordinary conversation, but also in some degree different. In ordinary conversation the parts are subject to no great strain; and more or less frequent intervals of rest are afforded, during which the mucous membrane can recover its normal condition. But in the continuous and strong exertion of the voice constantly made by public speakers and singers, the mucous membrane is especially liable to become irritated by the forcible contact, and rapid passage over it, of cold dry air drawn in at each inspiration through the mouth, and not warmed and moistened by passing through the nasal fossæ. To allay the irritation and mitigate the dryness thus produced, the mucous follicles are stimulated to increased activity, and for a time are able to secrete a sufficient quantity of mucus for the lubrication of the surface. Ultimately they are liable to become inflamed and hypertrophied. Further, it is worthy of note that the mucous membrane covering the arytenoid cartilages, and immediately adjoining parts, is more rich in glandular structures than any other portion of the laryngeal mucous membrane. Now this part is constantly subject to a very great extent of motion, and also, perhaps, to considerable strain, during forced vocalization. And thus its glands are especially liable to be stimulated to increased activity; and the morbid condition under discussion may eventuate.

It is important to bear in mind, however, that chronic glandular laryngitis may, and indeed often does, occur in persons who have not been subject to any such continuous vocal exertions as those above referred to. In such cases exposure to cold and fog (especially if there is any obstruction of the nose), and the constant inspiration of air charged with irritating fumes or particles, appear to be the most frequent causes. Gibb states that he has seen this malady "in a very exaggerated form in photographers, and persons much exposed to the fumes of acrid chemicals in confined chambers, and its obstinacy in them is something quite remarkable."[1] It is possible also that some constitutional tendency may favor the development of the malady. Indeed, Trousseau, Chomel, De Mussy, and others attribute its origin to the "herpetic diathesis."

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[1] Traité de Thérapeutique, par Trousseau et Pidoux. Vol. ii., p. 840. Paris, 1869.

[2] Ibid., vol. i., p. 172.

[3] This affection appears to have been first accurately and fully described by Dr. Horace Green, of New York, to whom also is due the credit of having especially taught and insisted upon the proper method of treating this and other affections of the larynx by the topical application of solutions of nitrate of silver, etc. See a Treatise on Diseases of the Air Passages, by Horace Green, M.D., New York, 1846.

The *symptoms* are: alteration of the voice, and sense of effort in sustaining it—these are by far the most prominent and constant symptoms; more or less discomfort about the larynx, never amounting to pain, but occasionally troublesome; dryness, and sometimes a sense of heat about the throat; and constant desire to clear the throat by "hemming" and "hawking." There is little or no regular cough; and the expectoration which sometimes occurs, is slight, scanty, and mixed with saliva. There is neither difficulty in swallowing, nor tenderness upon pressure over the larynx. There are no definite constitutional symptoms; but the general health and spirits of the patient are often observed to be more or less depressed.

The alteration in the voice depends upon the swollen condition of the arytenoid mucous membrane, which prevents the free movement of the cartilages, and thereby the necessary approximation of the vocal cords. The character of the voice varies somewhat. In the earlier stages it is simply wanting in clearness, and tone, and general reliability. In the later stages it becomes disagreeably harsh, husky, and hoarse. Sometimes it fails altogether, and the patient speaks in a husky whisper. As a general rule the alteration in the voice is most pronounced in the early morning, before the vocal organs have been at all exercised, and again in the evening, or after any considerable exertion of the voice, when the parts have become fatigued. Sometimes the patient will feel that he is able to carry on ordinary conversation with ease; but directly he begins to read or speak continuously in a loud voice he finds it impossible to proceed; or he only does so with great difficulty, sense of effort, and subsequent fatigue.

On inspection, the mucous membrane of the fauces and back of the throat is usually seen to present a more or less raw and irregularly granulated appearance; and the enlarged glandules, each, (it may be) surrounded by a little halo of undue redness, may be recognized studding the surface. *Laryngoscopical examination* shows that the mucous membrane of the larynx is similarly affected; and in some cases, as already indicated, the malady is confined to the larynx. The parts most frequently and most obviously affected are, as might be expected, those in which the glandules are most abundant. These parts are the mucous membrane covering the arytenoid cartilages, the inter-arytenoid folds, the base of the epiglottis, and the ventricles and sacculi of the larynx. In cases of long standing, points of ulceration may sometimes be observed, especially about the base of the epiglottis. In others the glandules appear to be not simply enlarged, but distended with opaque yellowish material.

The mucous membrane covering the vocal cords is very thin, and contains very few, if any, glandules. It is very rarely, therefore, observed to be affected in this malady. It occasionally presents, however, isolated granulations which might possibly be mistaken for enlarged glandules. Such a condition is described by Türck under the name of *Chorditis Tuberosa*.[1]

The *course* of chronic glandular laryngitis is very tedious, and its *duration* very long, often extending over months or even years. It is not readily amenable to treatment; but by perseverance much good may generally be effected. Certain forms of new growth occasionally met with in the larynx may not improbably owe their origin to the localization of this or some allied affection of the mucous glandules.

Treatment.—The method of treatment, which experience has shown to be the most effectual, consists in the application by the brush of solutions of nitrate of silver or perchloride of iron, at intervals varied in frequency according to circumstances. The nitrate of silver, I believe, is, as a rule, the best application. Sulphate of zinc, sulphate of copper, and tincture of iodine,[2] have also been recommended, and indeed it may be stated that it is often well to vary the application. That which answers perfectly in one case, or at one period, proves less efficacious in others, or at other periods and under changed conditions in the course of the same case. Any points of ulceration tha may be seen should be touched by mean of the probe with solid nitrate of silver Between such applications spray shoul be inhaled at frequent intervals durin the day. The best solutions for the pu pose are those of common salt, chlorid of ammonium [biborate of sodium, b carbonate of sodium, chlorate of pota sium], iodide of potassium, and in som cases alum, or weak solutions of perchl ride of iron. Certain mineral water especially such as contain the sulphides of sodium or calcium, have also been strongly recommended, as well as artificial solutions of sulphurous acid.

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[1] On Diseases of the Throat. Op. cit., p. 2.

[1] See Op. cit., p. 164.

[2] Iodine, 1 part; iodide of potassium, parts; distilled water, 18 parts. (Krishaber

A method of treatment, which appears to be especially useful in this form of laryngeal disease, consists in slowly sucking medicated lozenges. The precise and careful observations of Fournié[1] prove (contrary perhaps to what might be expected) that certain portions of liquids swallowed, especially if swallowed slowly, or allowed almost insensibly to find their way down the pharynx, may become applied to the upper part of the larynx, and even diffuse themselves to some extent over its internal surface. The lozenges that appear to prove most useful are those containing chloride of ammonium, with or without cayenne, and the "red-gum lozenges," made by Messrs. Squire.

[These lozenges often offend the stomach, producing mawkishness, loss of appetite, and indigestion, on account of the sugar in their composition.]

In this, as in other chronic laryngeal affections, the beard should be worn; and all due general precautions should be taken; for, as need scarcely be stated, an attack of ordinary catarrhal laryngitis may be readily excited.

Tonics and other constitutional remedies, varied according to circumstances, often prove very beneficial. It is especially necessary to reassure the mind of the patient; for he is but too often depressed in spirits, and apt to think his malady far more serious than it really is.

PHTHISICAL LARYNGITIS.

The larynx is found to be more or less seriously affected in a very large proportion of cases of tubercular phthisis.[2] In some cases the earliest recognizable indications of the commencement of the malady appear in the larynx. In others, when the malady is fully established, the laryngeal symptoms are the chief if not the only source of the distress from which the patient suffers. In others again, the condition of the larynx gives rise to effects which may to a considerable extent mask or simulate the physical signs and symptoms of incipient, and even of advanced pulmonary disease; and thus the diagnosis may be rendered very difficult.[1] Hence the importance of making careful laryngoscopical examinations in all cases of suspected phthisis, and especially in such as present indications of laryngeal mischief.[2] There can be no doubt, I think, that most of the so-called "cures of consumption" said to have been effected by local applications and inhalations (in so far as the accounts given may be considered reliable) have occurred in cases in which the larynx has been principally, if not solely, affected.

In the very earliest stages, the [subjective] *symptoms* of phthisical laryngitis are simply weakness, uncertainty, slight huskiness, and occasional failure of the voice, together with a more or less constant desire to clear the throat of the thick whitish mucus which accumulates from time to time. [The earliest objective symptoms are pallor, and a thickening of the structures about the supra-arytenoid cartilages, giving the aryteno-epiglottic folds a peculiar pyriform or clubbed appearance at this point, due, as determined by microscopic inspection, to accumulation of *lymphoid* or *adenoid* elements.] On *laryngoscopical examination* the mucous membrane is seen to present a peculiar dotted granular appearance, which is usually first, and, as a rule, most conspicuously manifest on the posterior aspect of the epiglottis. This appearance is probably associated with the earliest deposit of tubercular material taking place in minute quantities at many distinct points. Somewhat later, the mucous membrane covering the arytenoid cartilages, and the aryteno-epiglottidean and inter-arytenoidean folds are affected, and sometimes present granulation-like elevations. At the same time more or less thickening of the mucous membrane may be observed. This thickening is an important and almost characteristic feature. It is to some extent due to increased deposit of tubercular material as well as to inflammatory infiltration. The false and true vocal cords, as a rule, become implicated only at a still later period, and usually on one side first. The false vocal cords partake of the general thickening, and often hide the true vocal cords; and these latter lose their clearness and brilliancy. As the malady advances, ulceration occurs in one part or other, and usually first on the posterior aspect and lower part of the epiglottis. At or about this period the voice becomes hoarse; breathing is carried on with a sense of effort, and sometimes with difficulty and pain; the cough (before rare, and indeed often little more than a more or less frequent "hemming") becomes constant, and sometimes painful; the expectoration is increased in quantity, and somewhat changed in character, becoming yellowish, and occasionally slightly streaked with blood; and sometimes, according to the position of the ulceration, there is pain in swallowing. So long as the ulceration is confined to the posterior surface of the epiglottis, swallowing is easy; but when the edges, upper border, and anterior surface of the epiglottis, and especially the glosso-epiglottidean folds are implicated, swallowing becomes painful. The ulcerative process, after it has once commenced, goes on; slowly it may be, but surely nevertheless. It extends gradually, not only superficially, but also in depth. Fresh centres of ulceration often appear, and by and by the deeper structures, areolar tissue, cartilages, etc., become involved, and in turn destroyed. Inflammatory swelling and œdema of the surrounding parts supervene. When the perichondrium is attacked the subjacent cartilage may either share in the ulceration and become gradually eaten away, as frequently happens to a greater or less extent with the epiglottis; or it may become partially or wholly necrotic, and may give rise to the formation of an abscess, in the midst of which the necrosed portions may remain for a longer or shorter period. The arytenoid cartilages appear to be most frequently and earliest liable to become necrotic; next, the cricoid cartilage. The thyroid is comparatively rarely affected in this way. It would seem that before becoming necrosed the cartilage generally undergoes a process of calcification. Concomitantly with these morbid changes, the expectoration becomes abundant and purulent; the voice is lost; breathing becomes more constantly difficult and painful; and from time to time the most distressing paroxysms of spasmodic dyspnœa may come on. Under such circumstances laryngoscopical examination is often very difficult, not only on account of the general state of the patient and the hyperæsthetic condition of the pharynx commonly existing in such cases, but also on account of the malposition, deformity, and swelling of the epiglottis resulting from the disease, and the abundant muco-purulent secretion by which the view is often completely obscured. When, however, a view is obtained, some idea may be formed as to the character and extent of the ulceration and destruction of parts that may have taken place. And it will usually be observed that the epiglottis and the posterior and upper parts of the larynx have suffered to the greatest extent; and that the ulcers are surrounded by more or less considerable thickening of the surrounding parts. Sometimes even projecting points of necrosed cartilage may be seen exposed, or bathed in pus. Post-mortem examination (the opportunity for which as a rule speedily occurs) confirms the correctness of such observations, as well as the inferences drawn from them.

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[1] Étude pratique sur le Laryngoscope et sur l'application des remèdes topiques dans les voies respiratoires. Par le docteur Édouard Fournié, Paris, 1863. Also L'Union médicale, 5 fév., 1863. p. 248.

[1] Louis states that he found ulceration of the larynx in 63 out of 193 cases of phthisis which he examined. Researches on Phthisis. By P. C. A. Louis, M.D. Sydenham Soc. Trans., Lond., 1844. According to the records of post-mortem examinations made at Guy's Hospital during the last six years, it appears that the larynx was affected in 47 out of 145 cases. The epiglottis is considered as part of the larynx; some cases, therefore, are included in these numbers in which the epiglottis only was affected.

[1] Cases occur from time to time in which affections of the larynx and trachea so closely simulate pulmonary disease that the patients are falsely supposed to be in a state of "hopeless consumption." On this subject see especially Dr. Scott Alison, On Morbid Conditions of the Throat in their Relation to Pulmonary Consumption, p. 10 et seq. London, 1869.

[2] See the excellent remarks of Dr. Marcet on the value of the Laryngoscope in the diagnosis of phthisis, in his work on Diseases of the Larynx. Op. cit. p. 80 et seq.

In some cases the ulcerative process does not commence so early, nor extend so deeply as thus stated; and it may even happen that healing may take place. In certain exceptional cases under favorable circumstances the process of healing may be watched from time to time by aid of the laryngoscope, as I know from my own observation, as well as from the statements of others. And further, it is by no means very unusual to find on post-mortem examination the cicatrices of healed ulcers in the larynges of those who have died of phthisis. In other cases thickening followed by softening, and it may be by subsequent absorption, without definite ulceration, may be observed to take place in localized patches. During this process there is abundant expectoration of thick whitish mucus. In all such cases the symptoms are proportionately less severe and the progress of the malady is much slower than in cases of the class first described. Post-mortem examination not unfrequently shows more or less pronounced affection of the larynx in cases in which during life there have been scarcely any laryngeal symptoms beyond slight hoarseness, or some other alteration of the voice.

The *course and duration* of phthisical laryngitis vary greatly, not only with the special character and type of the local affection, but also still more notably with the degree of development and severity attained by the pulmonary disease, and the general morbid conditions at the period at which the larynx first begins to suffer. Thus, in the first place, as already stated, the disease may begin in the larynx, and there may be no indications whatever of the presence of tubercle in any other part. In the second place, the larynx may appear to become affected almost simultaneously with the lungs, and the disease in the two parts may go on almost *pari passu*. In the third place, the affection of the larynx may be consecutive to advanced disease and disorganization of the lungs, and may even upervene, as it were, almost at the very ermination of the case.

In cases belonging to the first class inicated, the progress may be comparaively rapid, and the patient may die sphyxiated from the results of the laryneal disease alone; or exhaustion may ome on gradually. More frequently, owever, the progress of the malady is ow; and sometimes apparent or even tual recovery of temporary character ay take place. But sooner or later the alady appears afresh, often with greatly creased severity; and all the signs and mptoms of pulmonary mischief become anifest.

[Acute, and apparently primary, tuerculosis of the larynx, is almost sure be followed, within two or three weeks, y acute tuberculosis of the lungs; with fatal issue within from six to twelve eeks in most instances, and rarely reachng six months or longer.]

In cases belonging to the second and hird classes indicated, the downward proress is almost invariably more or less apid. It too often happens that the paient seems prematurely hurried to his nd by the difficulty of breathing and wallowing, and all the various sources of distress associated with the laryngeal complications of his fatal, but otherwise almost painless malady.

Treatment.—It would be altogether out of place to discuss in these pages the constitutional treatment requisite in tubercular affections generally, and in pulmonary phthisis especially. Suffice it to say, that similar constitutional treatment is indicated in phthisical laryngitis. It must ever be borne in mind that this malady is but a local expression, so to speak, of a general morbid tendency, to modify which all possible endeavors must be made. At the same time, the part affected is so important, and the associated danger and suffering may be so great, that no measures must be neglected by means of which the symptoms may be alleviated and the danger averted, if only for a time. Experience amply shows that in such respect ocal treatment is often very beneficial.

In the earliest stages it does not appear hat any topical applications are likely to e efficacious in arresting the malady; ut rest to the parts affected, and avoidnce of all sources of irritation, may fford opportunity for general improveent under constitutional treatment. But when once ulceration has commenced the need for local treatment arises, and indeed may become most urgent. Soothing inhalations of the steam from hot water, in which hemlock, hops, stramonium, or opium have been infused, often afford much comfort. So also do spray inhalations of anodyne solutions. Similar solutions applied by the brush are sometimes very useful. They may not cure, but they give the temporary relief the sufferer so often and so anxiously looks for. An excellent formula quoted from Krishaber[1] is as follows: Extract of opium and extract of belladonna, equal parts, dissolved in forty parts of cherry-laurel water. The beneficial effects of this application, although transient, are immediate and almost invariable. [Local applications of carbolic acid and compound iodine liquor, diluted in five or more parts of water or glycerine, are beneficial in many cases.]

Small ulcers may often be advantageously touched with the solid nitrate of silver: a protective covering from the irritating influence of the passing breath is thus formed for them. [Iodoform in powder, or in etherial solution, is often useful.] But the application of the solution of nitrate of silver to the mucous membrane generally, appears in many cases to do harm rather than good. Marcet recommends repeated scarification of the thickened parts of the mucous membrane.[2]

In cases in which the dyspnœa is great, and clearly dependent upon the condition of the larynx—in cases especially in which there is great difficulty in swallowing, and consequent danger of death from want of sufficient nourishment—tracheotomy should be performed without hesitation. The existence of even extensive disease in the lungs cannot be regarded as forbidding the adoption of this certain mode of relief from those symptoms which alone are distressing. Death from pulmonary phthisis is always easy; but death from laryngeal phthisis is preceded and attended by the direst suffering. Tracheotomy cannot ward off the one mode of death; but it is powerful to rob the other of its horrors. I have seen such immediate and such complete relief afforded by the operation in several cases, about the hopeless character of which there could be no doubt, that I should never hesitate to repeat it in similar cases, feeling certain that though life may not be saved, it may be prolonged, and suffering may assuredly be diminished during the remaining days. Further, it may be added, that cases do occur from time to time in which the whole

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[1] Op. cit., p. 95.

[2] Op. cit., p. 674.

disease is in the larynx, although the accompanying symptoms and wasting closely resemble those of general phthisis, and the physical signs are so far obscured as to afford no reliable indications. Three cases have come under my observation, in each of which the patient had been pronounced to be dying of "hopeless consumption." In each of these, more or less complete recovery speedily followed the performance of tracheotomy.

Syphilitic Laryngitis.

Syphilitic affections of the larynx are comparatively common.[1] They vary in character and importance with the period of the disease at which they arise, and also with the general health and condition of the patient.

During the *Secondary Stages* of Syphilis the mucous membrane of the larynx may be affected in a manner corresponding with the cutaneous eruption present; or it may become ulcerated, either independently, or in direct continuity with the characteristic ulceration of the soft palate, fauces, and pharynx, which so commonly occurs. The actual existence of the several conditions referred to has been fully established in very many cases, and may as a rule be readily recognized, by aid of the laryngoscope.[2] Without such aid the precise condition of the larynx in any particular case can only be inferred from the symptoms; and a considerable degree of uncertainty necessarily attends the diagnosis.[3]

Erythema of the laryngeal mucous membrane often occurs in association with syphilitic roseola of the skin. It may either extend from the fauces to the epiglottis and upper part of the larynx, and thence spread over the whole mucous surface; or it may appear in isolated, and more or less well defined patches. The mucous membrane in the parts affected presents on laryngoscopical inspection a dusky red or even purplish hue, and it may be, a slightly elevated or swollen appearance.

More distinctly elevated and better defined patches (*mucous patches*) are sometimes seen in association with papular, squamous, and especially with tubercular affections of the skin.

The *symptoms* accompanying these comparatively simple conditions are not, as a rule, severe; nor are the results likely to prove serious. The voice is generally altered to some extent: it may become weak, wanting in tone, husky, or somewhat hoarse. But there is neither dyspnœa nor troublesome cough; nor is there local pain, nor any difficulty in swallowing that can be referred to the affection of the larynx.

The peculiar character of the voice so constantly noticed in secondary syphilis, and by some considered almost pathognomonic, would appear to depend in great measure upon one or other of the conditions of the larynx thus described, rather than upon the concomitant affection of the palate, fauces, and nasopharyngeal mucous membrane, the existence of which is more readily obvious, and to which alone the explanation is commonly attributed. Such, at any rate, is the conclusion indicated by the results of my own observations, as well as by those of others. It must be borne in mind that an affection of the mucous membrane of the larynx which is only superficial, and to the eye of the observer appears slight, may nevertheless, directly or indirectly, hamper to a considerable extent the movements necessary for the production of the natural voice.

It sometimes happens that laryngeal symptoms, similar in character to those just described, and associated with similar laryngoscopical appearances, arise either gradually, or almost suddenly, five or six months after the commencement o the malady, and after all obvious affec tions of the fauces and pharynx hav subsided.

Syphilitic ulceration, as already stated may extend from the fauces and pharyn to the larynx. But it very rarely does s during the secondary stages, except i cases in which the general health an strength are much broken down, or i which there has been continuous or fr quent exposure, during the course of th malady, to the ordinary causes of acu laryngitis.

Occasionally small isolated spots superficial ulceration, similar to tho often observed in the mouth, appear the laryngeal mucous membrane.

During the *Tertiary Stages* of syphi the larynx is frequently affected in way or other, and in many cases to a very serious extent.

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[1] According to my own experience, a very large proportion (from thirty to forty per cent.) of the cases of laryngeal disease met with in hospital practice, among the surgical out-patients, are of syphilitic origin. In private practice the proportion is very much smaller, but still considerable.

[2] On this subject, see especially the brochure of M. Dance, Sur les éruptions du Larynx dans la période secondaire de la Syphilis. Paris, 1864.

[3] Gerhardt and Roth state that in eight out of fifty-four cases of secondary syphilis under observation in Würzburg Hospital, the hoarseness was produced by mucous patches or condylomata of the larynx, which could be distinctly seen by aid of the laryngoscope. Arch. für path. Anat., Bd. xxi., Heft 1.

Papulo-tubercular Elevations of the Mucous Membrane are by no means rare. They vary in size, and also in situation. In some instances they simulate warty growths of more innocent origin; in others they more or less closely resemble the condylomata met with on other mucous surfaces.[1] Sometimes these elevations subside under appropriate treatment, or perhaps spontaneously. In rare instances they increase to such size as to necessitate removal by operation. Sometimes they ulcerate and form the starting points of ulcerations, such as are described in the next paragraph. They have been observed on the false and on the true vocal cords, as well as on various other parts of the laryngeal mucous membrane. The chief *symptoms* noticed are hoarseness, or some other marked alteration of the voice, and sometimes occasional fits of dyspnœa.

Tertiary Ulcerations of the larynx are comparatively common. They may commence either superficially in the mucous membrane, and thence penetrate to the subjacent structures; or they may result from the effects of some more deeply seated affection—as for example softening down of gummatous deposits in the submucous tissue, or perichondritis or chondritis—followed by the formation of abscess. They may occur singly, and in any part; usually, however, several spots are attacked, either simultaneously or one after another. The epiglottis is generally affected first, and in a large proportion of cases is the part most extensively destroyed. Sometimes its edges are gradually eaten away; sometimes its substance early becomes perforated, and the perforation extends until the edges are reached. In such cases semi-detached portions, flapping loosely, occasionally give rise to much embarrassment. The false and true vocal cords are often affected—in some cases by comparatively superficial, but in most by deeply penetrating ulceration. The mucous membrane covering the arytenoid cartilages, and the posterior part of the larynx generally, is comparatively less frequently and less early attacked by syphilitic than by phthisical ulceration; but it is liable to become involved sooner or later. The cartilages (and especially the arytenoids) may become carious or necrotic, as the result either of deep extension of ulceration commencing in the mucous membrane, or of perichondritis arising independently of any such superficial affection. Portions of dead cartilage may become detached, and acting as foreign bodies, may give rise to the most serious symptoms; or they may be expectorated, or removed by operation; or they may remain at any rate partially fixed, and in such case may become the foci of abscesses, and the excitants from time to time of the most dangerous paroxysms of spasmodic dyspnœa.

The *symptoms* vary according to the extent of the ulceration and the part especially affected. There is invariably marked alteration of the voice, sometimes hoarseness, sometimes complete aphonia, and sometimes one or other of the various intermediate conditions which are readily recognizable but difficult to describe or name. There may or may not be dyspnœa; and the dyspnœa, if present, may be slight, or of the most distressing character. In some instances, and especially in those in which the cartilages are affected, there may be occasional attacks of severe dyspnœa, with intervening periods of comparative or even complete ease; and sometimes suffocative spasm of the larynx may occur.

Two or three years ago, a patient (in the Venereal Ward in Guy's Hospital) who had suffered from occasional and slight but evanescent attacks of dyspnœa, was suddenly seized with such urgent and distressing difficulty of breathing that he rushed from the ward to seek help. He reached the bottom of the stairs, and then fell dead from suffocation. On post-mortem examination, a detached portion of necrosed cartilage was found in the glottis.

It is well to bear in mind, therefore, that in such cases dyspnœa of the most dangerous character may supervene suddenly, and almost without warning. Indeed, it may be asserted that patients suffering from severe tertiary affections of the larynx require the most careful watching, for danger may arise at any moment. In some cases there is difficulty in swallowing; and often more difficulty in swallowing fluids than solids. The former (on account of the condition of the epiglottis) are more liable than the latter to "go down the wrong way." But the slight degree of difficulty, and the absence of all pain in swallowing, sometimes observed in certain exceptional cases of this kind, in which the epiglottis has been even extensively destroyed, are very remarkable.

The *course and duration* of these tertiary affections of the larynx, as may be readily understood, vary greatly. In some cases, under appropriate treatment, cicatrization may take place; but in such it constantly happens that very serious deformities of the parts result either from the loss of substance, or from the subsequent contraction of the cicatrices that may have occurred. The voice is, as a rule, permanently impaired; and breathing and swallowing may be rendered more or less difficult. Attacks of acute laryngitis, attended by more or less spasm, are liable to be excited by comparatively slight causes, and may lead to a fatal result if timely relief is not afforded, or if the safety of the patient has not been previously secured by the performance of tracheotomy.

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[1] M. Cusco has especially called attention to growths of this description, and to their syphilitic origin (see M. Dance, op. cit.). His observations accord with those of Türck and other observers, and are confirmed by my own experience.

The *general diagnosis* of syphilitic affections of the larynx is not often difficult. The history of the case, and the presence of the syphilitic cachexia, together with the coexistence of some more unmistakable signs or symptoms (such as ulcers or cicatrices about the palate and fauces, cutaneous eruptions, nodes on the tibiæ, etc.) generally serve to indicate the nature of the malady.

But beyond the general indications afforded by the history of the case, and by the presence or absence of other local affections of syphilitic origin, certain special indications may be obtained, and the diagnosis may often be clearly established, by aid of the laryngoscope.

The dusky hue and patchy appearance of syphilitic erythema of the larynx differ notably from the bright diffused redness of simple catarrhal inflammation; and the papules, flattened tubercular elevations of surface, and condylomata of syphilis can hardly be mistaken for the enlarged mucous follicles of glandular laryngitis—still less for the dotted, granular appearances presented in the earlier stages of laryngeal phthisis. There may, however, be considerable difficulty in distinguishing between a syphilitic tubercle or condyloma beginning to ulcerate, and a small epithelioma, especially if situated on the posterior wall of the larynx. Such difficulty has arisen in more than one instance under my observation. In any doubtful case it is well to try the experiment of "specific" treatment before expressing any decided opinion. Antisyphilitic remedies and local treatment will almost certainly effect a cure in the one case; and in the other, though necessarily useless, they cannot do any great amount of harm.

The deep and extensive ulceration of the more advanced stages of syphilitic disease of the larynx not only gives rise to symptoms, but on laryngoscopical inspection may present appearances, which more or less closely resemble those of phthisical disease on the one hand, and epithelioma on the other. It may not be easy, but it is always important to determine accurately the nature of the malady, as well as the extent of the mischief. For, as need scarcely be stated, the treatment which is requisite and likely to prove more or less successful in cases of syphilitic origin, might be absolutely injurious in those associated with phthisis, and altogether useless, or perhaps worse than useless, in epitheliomatous disease. The prognosis also must obviously depend in great measure upon the satisfactory determination of the origin of the local affection.

The chief distinctive features presented by syphilitic, phthisical, and epitheliomatous ulceration of the larynx may be stated as follows.

Syphilitic ulceration usually attacks the epiglottis first. It extends rapidly, and is emphatically destructive in its progress. It involves the submucous tissues at a comparatively early period; and thus the whole thickness of the epiglottis may speedily become perforated, or some other part of the larynx may suffer corresponding destruction of substance. It is not, as a rule, surrounded by any marked or extensive thickening; but its edges are often more or less swollen, and red. Such apparent or real thickening as there may be generally attends rather than precedes the ulcerative process. The accompanying expectoration is thick, tenacious, and yellow or yellowish green in color.

Phthisical ulceration usually commences in the mucous membrane covering the upper and anterior parts of the arytenoid cartilages. The posterior aspect of the epiglottis may often be seen at the same time free from ulceration, but presenting the dotted granular appearance already described. It is almost invariably preceded as well as always attended by marked and characteristic thickening. It progresses comparatively slowly; and, as a rule, does not penetrate at an early period to the deeper structures. When it attacks the epiglottis, the edges present an irregular, somewhat worm-eaten and grayish appearance. The accompanying expectoration is generally more frothy and thinner, and more mucopurulent in character than in syphilitic ulceration and much more abundant than in epithe lioma.

Epitheliomatous ulceration of the laryn in a very large proportion of cases con mences on the pharyngeal aspect of th mucous membrane covering the arytenoi or cricoid cartilages, and comparativel rarely in the interior of the larynx. It associated with very considerable and i regular thickening, due to the develo ment and increase of the new growt Its surface presents a dirty grayish a pearance, and its edges are elevated. progresses very slowly. The accompan ing expectoration, at any rate during t earlier stages, is scanty, thin, and often more or less sanious in character. In the advanced stages it becomes abundant, more or less purulent, and sometimes tinged with blood.

The other local and constitutional signs and symptoms, which in syphilitic and phthisical cases may aid the diagnosis, are altogether wanting in cases in which the laryngeal ulceration is simply epitheliomatous in origin.

Lupous, and other strumous ulcerations of the larynx which cannot, strictly speaking, be classed as phthisical, sometimes occur,[1] and are with difficulty distinguished from those of syphilitic origin. In some cases of the kind that have come under my observation, it has seemed that the affection has probably been due to congenital syphilis. The age of the patient, the history of the case, and the presence or absence of other local or general indications, afford the best guides in the diagnosis.

Treatment.—In syphilitic laryngitis, local as well as constitutional treatment is very often necessary, and in the more severe forms is urgently—nay, imperatively demanded.

The comparatively slight affections which so commonly occur during the secondary stages of the malady, and in which there is simply diffused or patchy erythema of the mucous membrane with but little swelling, as a rule, subside under constitutional treatment. But all unnecessary exertion of the voice, and especially exposure to cold and wet, should be sedulously avoided. Mercury in one form or other is the only remedy upon which any reliance can be placed; and the appearance of laryngeal symptoms may generally be accepted as an indication that it is desirable to get the system under the influence of this drug as speedily as may be practicable and safe. The use of the calomel vapor bath may be especially recommended in such cases, inasmuch as beyond its general efficiency it affords special facility for the occasional inhalation, and thereby the local application of the mercurial vapor. The value of such inhalation, however, is more pronounced in cases in which ulceration has commenced.

Secondary ulcerations of the laryngeal mucous membrane (whether in continuity with others about the fauces or pharynx, or appearing independently) may often be advantageously treated by local applications. But such applications must be regarded simply as adjuvants to the general treatment indicated, and not as in any measure rendering such general treatment unnecessary. The frequent inhalation of the spray of weak solutions of perchloride of mercury with chloride of ammonium, or of sulphate of copper, very often appears to be beneficial. In some cases the insufflation of calomel, or an occasional inhalation of the vapor of calomel, may be recommended. In other cases the application of solid nitrate of silver or sulphate of copper, from time to time, to the ulcerated surface does good. If there is much irritability, however, the inhalation of warm soothing vapors, or the spray of anodyne solutions, is for a time preferable.

Syphilitic affections of the larynx occurring during the tertiary stages of the malady almost invariably require the administration of iodide of potassium in full doses (gr. xx to gr. xxx) three or four times a day. In some cases the addition of iodine may be useful. In others, iodide of iron and tonics generally are indicated. Local measures are very often necessary in conjunction with the constitutional treatment indicated, and in all cases may do much to aid the cure. Condylomatous and papillary elevations of the surface may be touched daily, or less frequently, with the solid nitrate of silver. In cases in which ulceration has occurred, inhalations of the vapor of iodine, or of the spray of solutions of iodide of potassium and iodine, are very useful. If the ulcers are comparatively superficial, the application of solid sulphate of copper daily, or twice daily, often proves beneficial. If the ulcerated surface is extensive, a saturated solution of sulphate of copper may be advantageously applied by the brush. Cases occasionally occur in which the internal administration and also the local application of mercurials in conjunction with preparations of iodine are indicated. The more powerful applications and medicines may sometimes be beneficially alternated from time to time with the exhibition of chlorate of potash, both locally in the form of solution, spray, or powder, and internally in combination with tonics. Swollen and œdematous parts of the mucous membrane may be freely scarified with the greatest advantage; and any spot at which an abscess appears to have formed may be punctured. If any portion of exposed and necrosed cartilage should be seen, an attempt may be made to remove it by means of appropriate forceps.

In every case in which breathing becomes seriously impeded, whether in the secondary or tertiary stages of the malady, tracheotomy should be performed without hesitation. Ample experience proves that in syphilitic disease of the larynx this operation may be regarded as fairly successful, not only in averting impending danger, but also in affording opportunity for the more or less complete restoration of the parts affected.[1] The operation is especially called for in cases in which paroxysms of spasmodic dyspnœa have occurred, or in which laryngoscopic examination shows that the ulceration is extensive and deep, and some portion or other of necrotic or carious cartilage is exposed. In such cases recovery without operation, though by no means impossible,[2] is at any rate improbable; and the patient is in peril of his life (peril which at any moment may become imminent) until a new way of breathing is secured to him.

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[1] See Türck, op. cit., p. 425.

The cicatrices of syphilitic ulcers of the larynx have a great disposition to contract, and such disposition is favored in many cases by the loss of substance which may have occurred. Permanent impairment of the voice, and more or less impediment to respiration may result. It not infrequently happens that tracheotomy becomes necessary after partial or complete cicatrization has taken place, in consequence either of the resulting contraction of the parts, or of an attack of laryngitis incidentally occurring. The damaged parts are prone to a low subacute or chronic form of inflammation, which at any moment may become exacerbated and give rise to urgent symptoms. In some cases the passage gradually becomes more and more free in consequence of the absorption of effused material; and in such, if it should have been necessary to perform tracheotomy, the canula may be removed at an earlier or later period. In other cases the contraction increases, and the tracheotomy canula must be worn during the remainder of life. In some few cases it may seem desirable to divide the cicatrices by operation, and to attempt the dilatation of the air passage. But so far as I have been able to ascertain, no very satisfactory result has hitherto been obtained in any case in which the mischief has been in the larynx itself. Much good however has been effected in several cases in which the contractions have been situated above the larynx. Some encouragement to further attempts may perhaps be derived from the successful results which have been obtained in instances in which the contractions have resulted from the effects of injuries, although, as is obvious, the conditions in such cases must necessarily be somewhat different.[1]

ERYSIPELATOUS LARYNGITIS.

Erysipelatous Laryngitis in its severer forms is an extremely dangerous, but happily by no means a common affection. It is most frequently met with, perhaps, in hospital practice at periods when erysipelas is prevalent. It may either occur in association with erysipelas of the face and neck by direct extension to the fauces, and thence to the larynx; or the fauces and larynx may be first affected, and death may ensue without any appearance of erysipelatous redness on the external surface.

The *local symptoms* are:—soreness of the throat; difficulty in swallowing; pain and tenderness about the larynx; hoarseness, and subsequently extinction of the voice; and difficulty in breathing, which may rapidly become more and more urgent. These local symptoms are preceded and attended by the constitutional symptoms (such as feverishness, rigors, etc.) associated with erysipelas generally. On *inspection*, the mucous membrane of the fauces is seen to be unnaturally red and swollen, and sometimes more or less dry and shining. By aid of the laryngoscope, the mucous membrane of the larynx may be seen to be similarly affected. As the malady advances the submucous tissue becomes infiltrated; the swelling increases, and its œdematous character is pronounced; the glottis becomes more and more encroached upon, and respiration is consequently more and more impeded.

Unless the malady is checked in its progress, or relief is afforded from the urgent symptoms, the patient usually sinks into a "typhoid" state, and dies either from exhaustion or suffocation. Such is the common result.

On *post-mortem examination* the mucous membrane of the larynx appears inflamed, swollen, and œdematous. In many instances it is of a dirty greenish color in places; and the submucous tissue is infiltrated with seropurulent matter, and here and there sloughy. Small collections of pus and sloughs of the areolar tissue are occasionally seen round the glottis. The tracheal mucous membrane is also often found to be inflamed. The mucous membrane of the fauces is similarly affected; and the base of the tongue and the tonsils sometimes present a more or less extensive sloughy appearance.

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[1] I find that in 38 out of 72 cases of tracheotomy on account of syphilitic disease of the larynx which have come under my observation, or of which I have collected particulars, life was preserved. In 19 of these the patients were enabled sooner or later to dispense with the canula; in 10 it was necessary to wear the canula permanently; in 9 the ultimate results are not stated.

[2] See a remarkable case recorded by Gibb (op. cit., p. 38), in which a crater-like elevation was seen on one side of the glottis. From this, portions of the cricoid cartilage were discharged and expectorated on three different occasions.

[1] See the article on Injuries of the Neck. Vol. i., p. 694.

Treatment.—The general treatment must be from the first stimulating and supporting; and no effort must be spared to counteract the depressing influences of the disease. As much nourishing and easily digestible food as can be taken, together with a very liberal allowance of wine or brandy, should be given at frequent intervals in such proportions as can be swallowed. The tincture of the perchloride of iron with quinine should be administered in full doses, or some other powerful tonic combined with chlorate of potash, or ammonia.

In some cases it may be desirable to commence the treatment by the administration of an emetic followed by a purge. But the propriety of so doing must be decided by the general condition of the patient, and the progress the malady may have made. Locally, the application of a strong solution of nitrate of silver or perchloride of iron may be recommended in the earlier stages. In the more advanced stages, especially when there is much œdema, free scarification of the mucous membrane, and frequent inhalations of warm soothing vapors and steam may afford the most marked relief. If the dyspnœa becomes urgent tracheotomy must be performed. It is true that from the nature of the malady there is often but little hope of a successful result; at the same time there can be no doubt but that by the operation a chance of prolonging life is afforded that could not otherwise be obtained; and that by it at any rate the last hours of the patient may be rendered comparatively free from suffering.[1]

It may be worthy of remark that apart altogether from any such serious affection as that thus described, it not infrequently happens that in cases of erysipelas of the scalp and face, there is some soreness of the throat, slight difficulty of breathing, and some alteration of the voice, such as weakness or hoarseness.

DIFFUSE CELLULAR LARYNGITIS. ACUTE ŒDEMATOUS LARYNGITIS.

Diffuse inflammation of the areolar tissue of the larynx is a comparatively rare, but very formidable malady. It corresponds to the diffuse cellular inflammation not infrequently met with in other parts of the body; but it is especially dangerous on account of the impediment to respiration and swallowing to which from its situation it necessarily gives rise. It is probably closely allied in nature to erysipelatous inflammation, from which, however, it differs in the fact that in it the submucous tissue is primarily attacked, and the mucous surface is left free, or only becomes secondarily affected. In erysipelas, on the other hand, the mucous surface is first affected, and the submucous tissue is only secondarily or concomitantly involved.

Diffuse Cellular Laryngitis may either occur in association with previously existing diffuse cellular inflammation of the neck, in which case it seems to form a part of the more general affection; or it may commence in or about the submucous tissue of the pharynx and larynx, and thence spread through the neck generally. In some instances, however, it may cause death from suffocation or exhaustion before any considerable extension to other parts can have taken place.

In this malady the appearance of the local affection is usually preceded, and its onward progress is invariably attended, by more or less severe constitutional disturbance, and especially by great general depression. At the onset the patient often complains of having felt unwell for some days, and of having suffered from headache, lassitude, lowness of spirits, and other febrile symptoms. Soreness of the throat, at first slight, but rapidly becoming severe, is noticed early; and rigors soon occur. As the malady progresses breathing becomes impeded; and a sense of weight and oppression at the chest is complained of. There may be slight hacking cough, attended by the expectoration of a little whitish glairy mucus. The soreness of the throat increases; the fauces and tonsils become much swollen, and of a dusky red color; and sometimes ulcerated patches appear upon them. Somewhat later the glands behind and below the jaw become enlarged; the neck becomes painful; and the mouth can only be opened with difficulty. The throat is tender when external pressure is made on one side or both. Occasionally a constant and profuse discharge of saliva takes place. Still later, the neck becomes swollen, and the swelling extends and increases; respiration is more and more impeded; and swallowing is rendered almost or quite impossible. The patient sinks into a typhoid condition, and dies exhausted; or, as perhaps more frequently happens, he is killed by a process of slow asphyxiation. In some cases, however, a sudden paroxysm of spasmodic dyspnœa proves fatal at a comparatively early period in the progress of the malady; and in others, the laryngeal œdema increases very rapidly, and causes speedy suffocation. Either of such results may ensue before any considerable, or even any perceptible general swelling of the neck has taken place.

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[1] A fatal result ensued in 10 out of 15 cases of tracheotomy performed on account of erysipelatous laryngitis which have come under my observation, or of which I have collected particulars; in 5 cases the patients made good recoveries.

So far as I have been able to ascertain, no satisfactory laryngoscopical examination has hitherto been made in any severe case of this kind; and therefore the actual appearances during life cannot be described. They may, however, be predicated with sufficient accuracy from what has been constantly observed on post-mortem inspection. Moreover, the swollen and œdematous condition of the upper part of the larynx may generally be easily ascertained by digital exploration. In the earlier stages and less severe forms of the malady, laryngoscopical examination to some extent is comparatively easy; and the mucous membrane of the upper parts of the larynx may be seen to be distended and swollen, and dusky or palish in color. The color of the mucous membrane differs altogether from the bright scarlet redness of acute catarrhal inflammation. The lower parts of the larynx are more or less completely concealed from view.

On *post-mortem examination* extensive inflammatory œdema of the submucous tissue of the larynx and neighboring parts is invariably found. In some cases one side is much more affected than the other. When cut into, the areolar tissues present an infiltrated, and sometimes more or less sloughy appearance. The infiltration is serous, seropurulent, or purulent in character, according to the period at which death has occurred, and the circumstances under which it has taken place. The tissues of the neck are found in many cases to be infiltrated to a greater or less extent with serous, seropurulent, or fibrinous exudation. In cases in which there has been much swelling, they often present almost a brawny consistency. Sometimes the infiltration extends upwards behind the pharynx, sometimes downwards alongside the trachea and œsophagus, even into the mediastina. Occasionally the infiltration in the neck is purulent in character, and in some instances the areolar tissue is sloughy and putrid.

Treatment.—The same general treatment is required as that recommended in erysipelatous laryngitis. But in this malady local applications of nitrate of silver, etc., are far less likely to prove efficacious. The swollen parts should be freely and deeply scarified at a comparatively early period; and the scarification should be repeated without hesitation from time to time according to circumstances. After the scarification, warm soothing vapors should be frequently, or almost constantly inhaled for a time. At a subsequent period the spray of astringent solutions may be inhaled with advantage. Further, in cases in which the neck is much swollen, it may be desirable to make careful but free incisions into it, not only to evacuate pus or to allow of the escape of serous effusion, but also with the view of diminishing the tension and consequent pressure upon the trachea and œsophagus.

If such means fail to afford relief, and the dyspnœa is urgent, tracheotomy must be performed, although the difficulties attending the operation may be great, and the chances of a successful result may appear small.

An excellent illustration of the value of tracheotomy in cases of this kind occurred some few years ago in the practice of Mr. Pollock at St. George's Hospital.

The patient (a butcher, aged forty-three) was admitted with severe and extensive diffuse cellular inflammation of the neck. Urgent laryngeal symptoms soon supervened. Tracheotomy was performed, and the patient made a good recovery in a comparatively short space of time.[1]

OTHER FORMS OF LARYNGITIS. EXANTHEMATOUS LARYNGITIS; TRAUMATIC LARYNGITIS, ETC.

Consecutive inflammation of the larynx occasionally occurs in the course of various general maladies, other than those the laryngeal complications of which have been already described in detail. It is especially liable to occur in measles and typhoid fever. It is more rarely met with in smallpox and typhus, and still more rarely in scarlet fever.

The *Laryngitis of Measles* is catarrhal in character, and, in most instances, appears soon after the nasal catarrh. Respiration may be more or less embarrassed; and sometimes there is remarkable harshness of the voice, and frequent harsh cough. In young children the breathing is occasionally stridulous, and the cough ringing. The consequences are very seldom serious; but it is well to bear in mind that they may possibly become so. In some rare instances, dangerous, and even fatal œdema of the larynx has ensued: and in some, the œdema has persisted after the general symptoms have subsided. In such cases the laryngeal symptoms have appeared early, and from the first have been very acute. As a general rule, the mucous membrane of the larynx is simply affected in a manner corresponding to the cutaneous eruption; and the symptoms subside as the eruption disappears. It is not often that any local treatment is necessary or desirable, beyond the application of warm poultices and fomentations to the neck, and the inhalation of warm soothing vapors. If, however, the symptoms are severe and persistent, the same treatment may be required as that recommended in cases of acute catarrhal laryngitis (see p. 49).

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[1] See Lancet, September, 1863, p. 276.

The *Laryngitis of Typhoid Fever* is ulcerative and destructive in character.[1] It may either commence during the earlier or middle stages of the malady, concomitantly with the ulceration of the intestinal glands and mucous membrane, and speedily give rise to serious symptoms, or even to a fatal result; or its existence may first become manifest during the period of convalescence, and after all febrile symptoms have subsided. The ulcerations which occur during the earlier stages are generally situated either on the aryteno-epiglottidean folds, in the neighborhood of the arytenoid cartilages, or, according to Rokitansky, about the lateral walls of the larynx. They may give rise to more or less severe functional disturbance—often to cough, and difficulty of swallowing, and, somewhat less frequently, to difficulty of breathing. The difficulty of breathing usually corresponds to the amount of inflammatory œdema that may have occurred. It is sometimes difficult to determine how far the cough may depend upon laryngeal, and how far upon bronchial affection. It is probable that in a large proportion of cases, if the patient survive the general malady, these ulcerations heal favorably, like the corresponding intestinal ulcerations. But in cases in which the symptoms become manifest at a comparatively late period in the course of the malady, or in which ulceration goes on insidiously, and perhaps almost unnoticed until seeming convalescence has taken place, the perichondrium and cartilages (and especially the cricoid) are very liable to be implicated to a greater or less extent. Under such circumstances the consequences are often very serious. Necrosis of the cartilages may result in association with typhoid fever, not only from gradual penetration of the ulcerative process, but also in some cases as an effect of some deep-seated inflammatory condition commencing in or about the cartilages themselves.

A remarkable instance came under my observation in Guy's Hospital, while I was acting as Ward Clerk to the late Dr. Addison. A boy, ten years of age, had apparently recovered from typhoid fever. One morning he complained of pain in the throat. A day or two afterwards he expectorated some pus. The next day his neck was observed to be swollen and emphysematous. The emphysema rapidly spread over the whole body, even to the scrotum and penis, which became enormously and peculiarly distended. Two days later death occurred. On post-mortem examination a small ulcerated opening, leading down to a necrosed portion of the cricoid cartilage, was found below the glottis, on the right side. Through this opening evidently the air had escaped during expiration into the areolar tissue of the neck, and had thence spread over the body. No other case of any kind has ever come under my observation in which the emphysema was so extensive and so general. The cavities as well as the superficial parts of the body were affected; and indeed it appeared probable that death had resulted from the impediment to respiration caused by the intrathoracic emphysema.

In a certain proportion of cases in which the symptoms are not severe, recovery may take place without any local treatment beyond the application of warm fomentations to the neck, and the inhalation of warm soothing vapors. The general treatment of typhoid fever must, of course, be carried out. In all cases, however, in which the symptoms are urgent, tracheotomy should be performed. It is undeniable that the statistical results hitherto obtained, do not appear to be very encouraging.[1] At the same time the success which has resulted in some cases justifies resort to this operation, which indeed alone offers any chance of safety.

In the *Laryngitis of Smallpox* the mucous membrane is affected in a manner which varies with the stage of the malady, and corresponds more or less closely with the more obvious external appearances. In the earlier stages, pustules may arise analogous to those observed on the cutaneous surface. Neumann, Türck, and Krishaber, all state that they have seen, by aid of the laryngoscope, true variolous pustules, surrounded by circumscribed inflammatory areolæ, upon the true vocal cords, as well as on other parts of the laryngeal mucous membrane. The symptoms are, hoarseness, cough, and more or less uncomfortableness or pain about the larynx. About the eleventh or twelfth day, at the period at which swelling of the face and extremities is especially liable to occur, œdema of the larynx may come on; and respiration may be more or less seriously, or even fatally impeded. During the still more advanced stages of the malady, at or about the period at which abscesses are occasionally formed in other parts, perichondritis and subsequent necrosis of cartilage, with all the attendant symptoms and dangers, may ensue.

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[1] This affection is the *laryngo-typhus* of the Germans. It appears to have been first definitely and fully described by Louis, in whose treatise, entitled Recherches sur la Fièvre typhoide (Paris, 1841), much valuable information on the subject is contained. Trousseau especially refers to the laryngeal complications of typhoid fever, and gives some excellent illustrative cases in his Clinique médicale, vol. i., p. 299; Paris, 1868. Chomel, Rokitansky, Wilks (Med. Times and Gaz., 1862, p. 276), and others also fully discuss the pathological history, or give examples of typhoid disease of the larynx. The appearance of the ulcers is so characteristic that Louis says that, if observed in a patient who had died of some acute disease, they would be sufficient to indicate almost certainly that the affection had been typhoid fever. Op. cit., p. 321.

[1] I find that out of thirty-five recorded cases in which tracheotomy was performed on account of "typhoid" disease of the larynx, in twenty-four death ensued. In eleven life was saved; but in several of them the voice was permanently impaired, and the canula could never be dispensed with.

In *Scarlet Fever* the larynx may either be affected during the earlier stages by extension of inflammation or inflammatory œdema from the pharynx; or, in common with other parts, it may become œdematous as the result of consecutive kidney disease. The true scarlet-fever eruption very rarely indeed, if ever, invades the larynx. The local treatment necessary in each case may be gathered from what has been already stated in regard to similar affections arising in connection with other maladies.

It may here be remarked that in *Bright's disease* the larynx may participate in the general œdema, and this may prove dangerous or fatal from the obstruction to respiration to which it gives rise.

Gouty laryngitis may possibly be considered to possess small claim to be described as a distinct form of disease. But it is worthy of remark that in gouty subjects chronic laryngeal affections are by no means uncommon. Sometimes they are very troublesome, and even distressing to the patient; and they are always difficult to treat successfully unless the existence of the general condition upon which they depend is fully recognized, and modified by appropriate constitutional remedies. In many cases they occur in association with gouty bronchitis and tracheitis, but even in some of these the laryngeal symptoms may attract most attention, and give rise to most trouble and danger. In certain rare instances acute laryngitis of very formidable character has been observed to occur in connection with an attack of gout.

Traumatic laryngitis has been already described in the chapters treating on the various injuries—as wounds, blows, burns, etc.—from which it may result (see Article on INJURIES OF THE NECK, Vol. I.).

NEW GROWTHS. POLYPI, ETC.

New growths in the larynx were formerly supposed to be of very rare occurrence; and indeed, except in some few and very remarkable instances, their presence could only be determined on post-mortem examination. Since the laryngoscope has come into use, however, a large number of cases have been recorded; and many more at present unpublished have come under observation, in which growths in the larynx have not only been recognized during life, but have been successfully removed by operation. There is probably no other class of cases in which the value of the laryngoscope has been so signally demonstrated. It would appear not unlikely that this circumstance, together with the interest naturally attaching to cases of this kind and the attention consequently attracted to them, has been the means of leading to the now prevalent idea that they are even more common than is actually the fact. They are certainly more frequent than was formerly supposed; but they nevertheless constitute only a very small proportion of the affections of the larynx that come under every day observation. Krishaber states that such growths are to be "met with in two or three per cent. of the cases of maladies of the larynx exclusively local and chronic."[1] My own experience would lead me to the conclusion that they are much less frequent even than this.

The new growths in the larynx met with in different cases vary in character, size, and precise situation, and also to a corresponding extent, in the symptoms to which they give rise and in the degree of danger they immediately involve. They may occur at any period of life; in some instances they are congenital;[2] in others they do not appear until advanced age. They are almost equally common in the two sexes. No satisfactory conclusion has yet been arrived at as to the local or general determining causes of their appearance in the majority of cases. In some instances, however, they may be of syphilitic origin; in others the so called new growths may be simply the thickened elevations of surface, or the "vegetation-like" granulations of phthisical laryngitis.

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[1] Op. cit., p. 730.

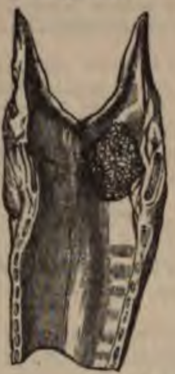
[2] One case has come under my own observation in which it was evident that the growth had commenced before, or immediately after birth. Another case, also congenital, is recorded by Mackenzie (Path. Trans., 1865, p. 38). Three are recorded by Gibb (op. cit.) and several are quoted by Causit in his Étude sur les Polypes du Larynx chez les Enfants Paris, 1867.

Some approximative idea as to the relative frequency of the different kinds of new growth met with in the larynx may be obtained from the following table, which has been carefully compiled from the published records of cases, from the results of my own observations, and from the descriptive catalogues of various museums.

Nature of growth.	Number of cases.	Number in which the growths were recognized during life.	Number in which they were only found after death.
Papillomatous or warty	110	65	45
Fibrous	23	13	10
Fibrocellular. Sarcomatous, etc.	52	47	5
Glandular. Adenomatous	6	2	4
Cystic	14	9	5
Cartilaginous	4	...	4
Epitheliomatous. Cancerous	19	8	11
Not clearly indicated	16	14	2
Total	244	158	86

Papillomatous or Warty Growths, as will be seen by the above table, constitute a large proportion of the new growths met with in the larynx. In structure and appearance they bear a general resemblance to growths of similar nature found in other parts; they may occur either as little warty elevations, consisting of comparatively few, and sometimes almost acuminated papillæ, or as closely packed and multitudinous villous or filipendulous outgrowths, or as densely massed "cauliflower-like" agglomerations of elongated and enlarged papillæ, rounded or flattened at their extremities. They most frequently, perhaps, spring from the mucous membrane of the anterior part of the larynx, somewhere near the insertion of the true vocal cords. In many instances, they take origin from the boundaries of the ventricles, and in some from the true vocal cords; but they may arise from almost any part of the laryngeal mucous membrane. As a rule, they are multiple in origin, and spring up simultaneously or successively in several different places. Sooner or later, they more or less completely coalesce so as to form one or many distinct masses. Some idea of the general appearance presented by growths of this kind, may be conveyed by Fig. 560, which is taken from a preparation in the Museum of Guy's Hospital.[1] The growths in this case form a single mass, which cannot be considered as otherwise than of moderate dimensions when compared with those met with in many other instances. It was sufficiently large, however, to lead to a fatal result. In some cases these growths increase very rapidly, and to such an extent as to fill altogether, and sometimes even to distend the cavity of the larynx.

Fig. 560.



Papilloma of larynx springing from border of left ventricle. Larynx opened in front.

A very remarkable instance is recorded and figured by Bruns.[1] In another case of the same kind, of four or five years' standing, in which I removed the growths after having laid open the larynx, it appeared remarkable that such a mass as was removed could ever have found room in so small a space.[2] The laryngeal mucous membrane was literally covered by growths, which varied in size and density. The patient nevertheless made a rapid recovery, and has now a very fair voice.

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[1] Preparation No. 1703.

[1] Op. cit., Beobachtung viii.

[2] Tracheotomy had been performed about four years previously.

In most cases the rapid increase of the growths, or the general inflammatory condition which may arise in association with their presence, and the consequent obstruction to respiration, render tracheotomy necessary, or without this operation, lead to a fatal result at a comparatively early period. But in some instances patients suffering from laryngeal growths of this kind have been known to live for years. In such cases, it is probable that the larynx has been kept sufficiently clear for breathing purposes by the detachment and expectoration of portions of the growth from time to time during coughing. Türck records a case in which the whole growth appears to have been thus got rid of.[1]

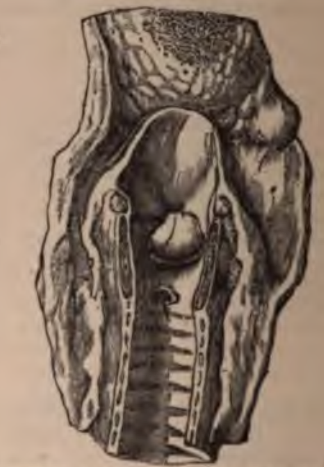
I have at the present time a little girl under my care in Guy's Hospital, whose trachea I opened three years ago on account of a growth of this kind, and with the view of subsequently removing the growth. The parents, however, objected to any further operation. The child's voice has improved, and the growth is now visibly smaller than it was two years ago when I previously examined her laryngoscopically. She cannot, however, dispense with the tracheotomy canula, although she is able to some slight extent to breathe through the natural passage.

According to some observers, it would appear that these papillomatous growths occasionally undergo a process of pulpy or caseous degeneration.[2] In such case it is easy to understand that they may become broken down and expectorated.

Fibrous and Fibrocellular Growths are met with in the larynx much less frequently than the papillary growths above described, but numerous instances are on record.

These growths are smooth on the surface, hemispherical, globular, or pyriform in shape, and on laryngoscopical inspection they appear somewhat paler in color than the mucous membrane of the surrounding parts. In substance they are more or less firm and compact. In structure, they resemble growths of similar nature developed in other parts; as a rule, they are solitary; they may be sessile with broad base, or pedunculated. If pedunculated, the pedicle is generally less firm and more vascular than the growth itself. In a large proportion of cases these growths are comparatively small, and do not each exceed the size of a pea; but they may attain considerable dimensions. In an instance referred to by Rokitansky, the growth was as large as a pigeon's egg.[1] A pedunculated fibrous growth of medium size is represented in Fig. 561, which is taken from a specimen in the Museum of Guy's Hospital.[2]

Fig. 561.



Pedunculated fibrous polypus of the larynx arising near the anterior extremity of the right ventricle of the larynx.

The larger pedunculated growths generally take origin from one or other of the true vocal cords, or from some immediately adjoining part of the ventricular wall—and in the latter case most frequently near the anterior extremity of the ventricle. They may, however, arise in other parts of the larynx, but they very seldom do so; in scarcely any instance has a growth of this kind been found connected with the mucous membrane covering the arytenoid cartilages.

Adenomatous or Glandular Growths are occasionally but rarely met with in the larynx. As a rule, they take origin from the mucous membrane covering the arytenoid cartilages, the aryteno-epiglottidean folds, or the base of the epiglottis,—or in general terms from those parts o the mucous membrane which are naturally most abundantly supplied wit glandular structures. In this respec they differ remarkably from all othe laryngeal growths of non-malignant cha racter. They consist essentially of enlarged and hypertrophied glands and follicles, surrounded by more or less thickened submucous connective tissue and mucous membrane. Occasionally they appear to contain adenoid structures of new formation. They may be sessile or pedunculated. When sessile (localized glandular hypertrophy of the mucous membrane), they often present a more or less lobulated appearance; and in some instances they attain very considerable dimensions.[1] When pedunculated they are usually more or less pyriform or globular, and their peduncles are proportionately longer than those of the fibrous polypi. When seen during life, by aid of the laryngoscope, these growths are generally of a deepish red color, but they often become pale as they advance in age. They are remarkable for the rapid changes in volume they are liable to undergo under various circumstances. Thus a slight attack of catarrhal laryngitis is almost sure to be attended by speedy and considerable increase in the size of the growth, which, may, however, again become smaller as the inflammatory condition passes off.

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[1] Klinik der Krankheiten des Kehlkopfes. Op. cit., Fall lxix., p. 305.

[2] See M. Causit, Étude sur les Polypes du Larynx chez les Enfants. Paris, 1867.

[1] Zeitschr. d. k.k. Gesellsch. d. Aerzte Wien, 1851, quoted by Krishaber. Op. cit p. 730.

[2] Preparation No. 1703^{20}. Tracheotomy ha been performed in this case; and the patie had for a long time been comparatively co fortable, but voiceless. One day the tube g displaced. Spasm of the larynx, conjoin with the mechanical obstruction caused the growth, proved immediately fatal.

Cystic Tumors of various kinds are met with from time to time in the larynx; but instances are comparatively rare. In some cases they may possibly result from the degeneration and breaking down of myxomatous growths, as suggested by Cornil and Ranvier;[2] but more frequently, probably, they owe their origin to causes corresponding to those which lead to the development of similar cysts in other parts. In some cases their contents are serous, or serosanguinolent; in others mucous, albuminous, or synovial in character. They may occur in almost any part of the larynx, and in some cases have attained considerable size.[3]

An interesting, and I believe almost unique example of mucous cyst connected with the posterior aspect of the epiglottis, came under the care of Dr. Wilks and myself in Guy's Hospital some few years ago. The patient, a delicate boy eleven years of age, had suffered two years previously from a severe attack of sore throat, and ever since had experienced more or less difficulty in swallowing. This difficulty gradually increased. His voice soon became affected, and by-and-by he began to suffer from frequent and severe attacks of dyspnœa, which often came on during sleep. On laryngoscopic examination, the epiglottis was not to be seen presenting its ordinary form; but instead of it there appeared a large rounded swelling, projecting downwards and backwards, and completely covering in and concealing the glottis. The tumor was pale in color, shining, and somewhat translucent in appearance. It could be just reached by the finger, and was elastic, but very tense to the touch. Feeling certain that it contained fluid, I made a free incision into it, by means of a curved, sharp-pointed bistoury. A sudden gush of thick, glairy, muco-purulent matter took place; and after the momentary dyspnœa which occurred had subsided, the patient was relieved of all the symptoms from which he had before suffered so severely. He made a rapid recovery, and left the hospital quite well. I examined him laryngoscopically four years afterwards (as well as from time to time in the interim), and could discover no indications of any return of the disease, nor indeed any very clearly perceptible mark of my incision.[1] A case of somewhat similar kind is recorded by Delorme, in which two cysts, with glairy albuminous contents, were found on the posterior aspect of the epiglottis of a man forty years of age, who died asphyxiated.[2]

It is worthy of remark, perhaps, that *true hydatid cysts* are stated to have been found in the larynx in some few very exceptional cases.[3]

A few instances of *Cartilaginous and Osseous Growths* in the larynx are on record; but the accounts given, so far as I have been able to make out, are not altogether satisfactory.[4]

Besides the growths of the various kinds thus described, others of mixed form and character are occasionally met with in the larynx. Thus the fibrous, fibro-cellular, and glandular elements may vary in relative proportion in such manner and to such extent as may render it impossible to assign the particular growth under examination to any definite class. And so again some growths which superficially appear papillomatous may have firm fibrous bases. And, further, the condylomata of syphilis, the thickened elevations of phthisis, and the small protuberances resulting from localized chronic inflammation in some cases can hardly be distinguished from what more properly, perhaps, ought to be regarded as "new growths" in the strictest acceptation of the term.

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[1] See case quoted by Ehrmann. Histoire des Polypes du Larynx. Strasbourg, 1850.

[2] Quoted by Krishaber.

[3] See a remarkable case described by Gibb (op. cit., p. 154), in which the tumor apparently sprang from the right ventricle, and filled nearly the whole glottis.

[1] See Transactions of Royal Med.-Chir. Soc., vol. xlvii., 1864.

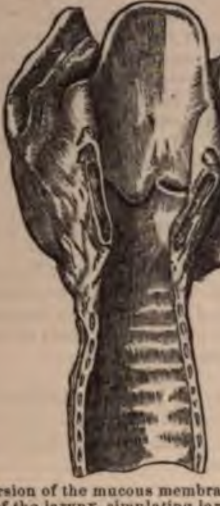
[2] Journ. de la Société de Médecine de Paris, janvier, 1808.

[3] Albers, Gazette médicale, fév. 1835; and Andral, Anat. path., tome ii., p. 490, quoted by Ryland, On the Diseases and Injuries of the Larynx, Lond., 1837, p. 226.

[4] See Ryland, op. cit., p. 231; Edin. Med. Journ., vol. xxxv.; Krishaber, op. cit., p. 769; Türck, op. cit., Fall lxxxi., p. 321.

A very interesting specimen was almost accidentally met with some short time since in the post-mortem room at Guy's Hospital, in which there was extroversion of the mucous membrane of the left ventricle of the larynx. Fig. 562 conveys a somewhat feeble idea of the appearance presented. The extroverted mucous membrane could be easily replaced in its proper position; and when this was done there was nothing abnormal in the appearance of the larynx. The patient had had no laryngeal symptoms.[1]

Fig. 562.



Extroversion of the mucous membrane of the left ventricle of the larynx, simulating laryngeal polypus.

Cancerous Growths in the larynx are, for the most part, *epitheliomatous* in character; but instances of *medullary cancer affecting the larynx* are not wanting.

Epithelioma of the larynx generally commences on the pharyngeal aspect of the mucous membrane covering the arytenoid or cricoid cartilages, and subsequently invades the interior of the larynx. But in some instances it commences inside the larynx; and in such cases, as a rule, it first appears on the mucous membrane of the posterior and lower part, over or near the internal surface of the cricoid cartilage, in the form of small irregular nodules, which gradually increase in size and soon ulcerate. Three instances of epithelioma commencing in this situation, and in the manner described, have come under my own observation. In each the precise position and character of the growth were recognized at a comparatively early period; and in each the result of the case established the correctness of the diagnosis. The distinctive features of advanced epithelioma of the larynx, as seen by the aid of the laryngoscope, have been already described (see p. 60).

The *symptoms* to which "new growths" or "polypi" in the larynx give rise vary in character and severity with the dimensions and precise relations of the particular growths under observation; and also with the intensity of the inflammatory condition which in many cases may be excited by their presence, or at any rate may be sooner or later associated with it.

Difficulty of breathing, alteration or extinction of the voice, cough, and, it may be (especially in the case of cancerous growths) difficulty of swallowing; these are the symptoms—as indeed they are also the symptoms, varying only in intensity and urgency—in all serious affections of the larynx, as well as in some other maladies in which the larynx is only indirectly affected. It is very rarely indeed, if ever, that any one of these symptoms manifests such peculiarities as may be considered to indicate the presence of a "new growth."

In many cases when the patient first comes under observation the difficulty of breathing is so urgent, or becomes urgent so speedily, that tracheotomy must be performed before any exact diagnosis can be made. The difficulty of breathing may depend either upon the mechanical obstruction caused by the growth, or upon spasm of the larynx excited by an incidental contact of the growth with some unaccustomed, or already irritated part of the highly sensitive boundaries of the glottis. A growth may exist for a long time almost harmlessly, moving in correspondence with the respiratory movements of the larynx, and then all at once may get into such position as to excite the most severe attack of spasmodic dyspnœa. This is especially likely to occur in the case of pedunculated growths. It may occur in other cases, if from any cause an attack of ordinary laryngitis should supervene. Sessile growths by their gradual increase may gradually constrict th aperture of the glottis, and thus proportionately impede respiration, withou giving rise, at least during their earlie stages, to any such suddenly serious an dangerous results as those thus indicated

In the case of growths situated belo the glottis it may happen that expiratio is almost as much impeded as inspiratio

In some cases by means of the steth

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[1] The case is fully described by Dr. Moxon, Trans. Path. Soc., 1868, p. 65. The preparation is in the Museum of Guy's Hospital. Preparation 1683.

scope placed over the larynx a sound produced by the movements of the growth during respiration (the "bruit de drapeau" of the French) may be detected.

The voice is affected to a greater or less extent in almost all cases; and if the growths are small and situated on the vocal cords, the affection of the voice may be the only symptom of which the patient complains. The voice may be simply changed in tone and quality, and become harsh; or it may have the "cracked pot" or "Punch" sound; or it may be reduced to a hoarse whisper; or it may be altogether extinguished. In some exceptional cases the voice, at first seriously affected, has been noticed to improve to a certain extent with the increase of the growth.

In a considerable proportion of cases there is little or no troublesome cough. But if an attack of catarrhal inflammation should occur, the cough becomes especially distressing; and fits of spasmodic cough may be excited from time to time in any case in which a pendulous tumor is liable to get into obstructive position. Occasionally the patient becomes conscious of the presence of some cause of obstruction, and tries "to cough it up."

Slight mucous or mucopurulent expectoration may attend the cough; sometimes portions of the growths may be mingled with the expectorated material;[1] and, as already stated, in some exceptional instances considerable portions, and even the whole of the "new growths" have been got rid of in this manner.

Among the various affections which may give rise to symptoms similar to those thus referred to as caused by the presence of new growths in the larnyx, may be enumerated—chronic laryngitis with œdema; spasm of the larynx, from whatever cause; laryngismus stridulus; nervous aphonia; pressure upon the pneumogastrics or the recurrent branches by tumors, aneurisms, etc.; retropharyngeal abscesses; pharyngeal polypi hanging down or projecting into the larynx, etc. It is, however, in the present day altogether needless to discuss in detail the distinctive differences that may or may not be presented by the symptoms in these several affections. In all cases in which time and opportunity are at command the diagnosis may be readily determined by aid of the laryngoscope. In cases however, in which the symptoms are very urgent, whatever may be their cause, relief must be afforded and safety secured by tracheotomy or otherwise before any full inquiry can be entered upon: laryngoscopic examination may then be made under favorable circumstances at any convenient subsequent period. It occasionally happens in the case of growths taking origin low down, that they almost disappear under the vocal cords or into the ventricles during inspiration, and only come thoroughly into view during expiration.

It is worthy of note that in some cases, particularly in children who are difficult subjects for laryngoscopical examination, valuable, if not conclusive indications may often be obtained by digital exploration. The effort at vomiting commonly excited during the introduction of the finger into the pharynx causes the larynx to rise momentarily, and thus to come within easy reach.

Treatment.—Measures should be adopted for the removal or destruction of all nonmalignant new growths in the larynx as soon as practicable after their presence and probable character have been clearly ascertained. For it may be asserted without fear of contradiction that no patient can be considered safe who has in his larynx a new growth of any considerable size—that is to say, unless his safety has been secured by tracheotomy. And small growths, as already stated, are liable to enlarge more or less quickly, and often unexpectedly; and even while still small they may favor the supervention of dangerous inflammation.

In some cases it is absolutely necessary, and in others it may be desirable, to perform tracheotomy before proceeding to any further operative measures. Very many cases, however, have now occurred in which, without tracheotomy, growths have been removed from the larynx, not only with the best ultimate results, but also without having involved the patient even temporarily in any serious risk.

The advisability of performing tracheotomy as a preliminary measure must be determined by the urgency of the symptoms, and the probable difficulties and dangers of the proceedings about to be carried out.

A great variety of different methods have been devised and adopted for the removal of growths from the larynx. They may be divided into those in which the operation is performed by aid of the laryngoscope through the mouth and natural passages, and those in which access is first obtained to the interior of the larynx by means of incisions in the median line through the skin, cartilages, etc.

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[1] It may be interesting from an historical point of view, to quote the words of Ehrmann, writing in the year 1850: "Il n'existe, il faut le dire, qu'un *seul* signe certain de l'existence de cette maladie; c'est l'expuition de quelques parcelles du polype."—Op. cit., p. 31.

Table of Cases of Operations for the Removal of New Growths from the Larynx.[1]

Methods adopted.	Total number of cases.	Completely successful results.	Partially successful results.	Deaths.
A. OPERATIONS THROUGH THE MOUTH AND NATURAL PASSAGES:				
Direct application of caustics or powerful astringents	16	12	4	
Removal or crushing by forceps . .	37	33	3	1
Removal or crushing by wire snare .	32	28	3	1
Removal or destruction by the galvano-caustic wire or pencil . . .	5	3	2	
Removal by knife or scissors . .	20	14	5	1
Simple puncture	4	4		
B. OPERATIONS AFTER EXTERNAL INCISION INTO THE LARYNX, ITS CAVITY BEING MORE OR LESS COMPLETELY LAID OPEN	24	15	5	4
Total	138	109	22	7

The above table, compiled from published records of cases and the results of my own observations, may serve to convey some idea as to the relative frequency with which the different methods of operating specified have been deemed expedient, as well as the degree of general success that has attended the efforts hitherto made.

The table must be taken for what it may be worth. It certainly appears to indicate the methods of operating that have hitherto been found most successful. But it cannot for one moment be regarded as affording any trustworthy guide to the method that ought to be adopted in any particular instance that may come under observation.

In deciding upon the course to be pursued, it is necessary in every case to take into consideration not only the size, precise situation, and character of the growth, but also the age, development, and condition of the patient, together with his general and special powers of endurance. If success is not attained by the method first adopted, another may be tried. Several methods were put in practice in each of many of the cases included in the above table. But in every instance the case is referred to the method which finally proved successful.

A. Operations through the Natural Passages.

1. *The Application of Caustics and powerful Astringents* to growths in the larynx, may be accomplished by the several methods already described (see p. 44); in the case of small isolated papillary growths, such applications, several times repeated, are not unlikely to prove efficacious.

2. Small fibrous, fibroid, and fibrocellular growths, and small or large papillary growths may, in many cases, be successfully seized by means of properly-adapted *Forceps*, and either torn off and removed in mass, or so crushed as to lead to their destruction. In the case of multiple growths, the repeated use of the forceps is often necessary. Portion after portion may be removed either at the same sitting, or during a series of sittings at intervals, according to circumstances. This method is especially advocated by Mackenzie,[1] and the laryngeal forceps which bear his name (fig. 563), are, I believe, the most generally applicable, and therefore the best of all the instruments yet devised for such purposes. Forceps made upon the principle illustrated in Fig. 564 are also very efficient. Some of these forceps are made to open laterally, and others antero-posteriorly, like those represented in the figure. In some cases ordinary laryngeal forceps, such as those figured and described in the chapter on Foreign Bodies in the Larynx (see Vol. I., p. 712) have been used with perfect success.

3. For the removal of laryngeal growths by *the Wire Snare* it is necessary to employ a slender and appropriately curved instrument carrying a wire loop, which can be quickly and easily drawn home when once it has been made to encircle the growth. The instrument successfully used by Dr. Walker, of Peterborough, in the first case in which a laryngeal growth

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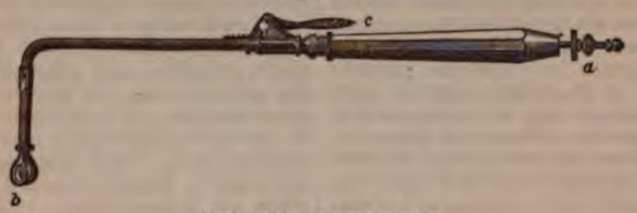
[1] In the cases specified as "completely successful" the voice was restored. In those "partially successful" the voice remained more or less impaired. In the fatal cases, with two exceptions, the growths were epitheliomatous or cancerous in character.

[1] Op. cit., p. 114.

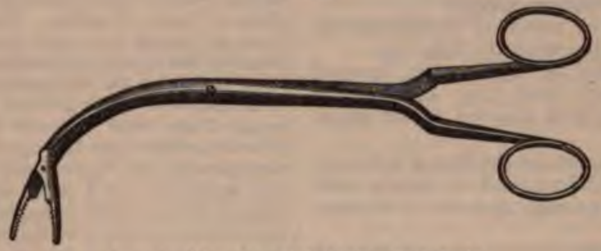
was removed from the larynx during life in this country, was a modification of Gooch's double canula.[1] But the double tube is cumbersome and altogether unnecessary. Gibb's Laryngeal Écraseur[1] is a far more perfect instrument—indeed, nothing could be better adapted for its purpose, unless it be some such modification as that suggested by Dr. George Johnson.[2] These instruments bear a general resemblance in construction and mode of working to Wilde's Aural Polypus Snare, and Hilton's Nasal Polypus Snare (see Vol. II., p. 250, fig. 300); but they are, of course, different in shape and more slender. In using this instrument the wire loop is made to encircle the growth, and then pulled tightly home. The growth is then forcibly pulled or twisted from its attachment, and, as a rule, is brought away in the loop. This method is strongly advocated by Sir G. D. Gibb,[2] and Dr. George Johnson.[3] It is especially applicable in cases in which the growths project in such manner and direction as to render them easily caught, and in which they are soft or pliable in texture, and not very large.

Fig 563.



Mackenzie's laryngeal forceps.

Fig. 564.



Laryngeal forceps, opening antero-posteriorly.

4. *The Galvanocaustic Method* was first practised by Middeldorpf, and has since been adopted by Voltolini, Türck, Bruns, and others. It has been still more recently recommended by Dr. Reichel, of Breslau.[4] This method consists in encircling and cutting off the growth by means of a platinum wire, which is so arranged in an appropriate carrier that when in position it can be intensely heated by means of a galvanic battery with which it is connected. The difficulties of this method are sufficiently obvious, and they, together with certain other practical objections to it, are clearly and forcibly stated by Bruns,[3] after some experience of its use. Its advantages in certain cases are equally obvious; and it would appear to be especially applicable in cases in which single fibrous growths exist, the peduncles of which are too strong to permit them to be safely torn away by means of the snare or forceps. A touch of the heated wire may be sufficient to dispose of small papillomatous growths.

5. *The Knife*, properly curved and guarded, or the *Laryngeal Scissors*, may be used for the separation of firmly attached growths which may have been seized but cannot be pulled off by the snare or forceps. Such means were adopted in several of the cases successfully treated by Bruns.[4] Several different

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[1] See Lancet, November 9, 1861, p. 444.

[2] Op. cit., p. 138.

[3] Op. cit., p. 173 et seq.

[4] Klinische Wochenschrift, No. li. 1869. Berlin.

[1] Made by Weiss; see Gibb, op. cit., p. 138.

[2] See Transactions Royal Med.-Chir. Soc., vol. li., p. 173 et seq.

[3] Die Laryngoskopie und die laryngoskopische Chirurgie, p. 244 et seq. Tubingen, 1865.

[4] See Table, op. cit., p. 254.

forms of laryngeal guillotine have been devised. Of these Mathieu's is probably the best. It has been used with success in several cases.

6. *Simple puncture* by the guarded bistoury or some specially contrived instrument (such as Mackenzie's laryngeal lancet) has proved completely efficacious in several instances in which the growths were cystic in character; and in such cases this method may be recommended. If in any case the cyst should fill again, it may be desirable on a second occasion to remove a portion of the cyst wall, or at least to make a more extensive incision than the previous one.

[7. *Transfixion of the growth* by means of a needle-knife passed through the cricothyroid membrane, or between the wings of the thyroid cartilage, and excision under guidance of the laryngoscopic mirror —a mixed operation, partaking of the nature of subcutaneous surgery.

8. *Excision* by means of sharp-eyed catheters made to sweep the interior.

9. *Detachment by dry sponges*, brushed rather roughly over the site of the growth; a method adapted to soft structures only.

10. Detachment by the finger-nail; applicable to children, and to adults with growths high enough up to be within easy reach.]

It is scarcely needful to add that all these several methods of removing laryngeal growths [save 9 and 10] require during their execution the guidance afforded by the laryngoscope.

B. Operations for the Removal of Laryngeal Growths after Exposure of the Cavity by External Incision and Section of the Cartilages, etc.[1]

In cases in which the growths are numerous, or very large, or single but firmly attached, and in those cases again in which the patients are young, and ill able to bear the introduction of instruments through their narrow natural passages, there can be no doubt, I think, that the easiest, most certain, and at the same time the safest method of operating consists in laying open the cavity of the larynx by external incision, and then removing the growths by scissors, écraseur, or galvanocaustic wire. The results of experience[1] encourage the further and more confident adoption of this procedure in all such cases as those referred to. It affords opportunity for the more immediate, complete, and effectual removal of the growths than can be obtained in any other manner. It is by no means difficult of execution, nor does it involve any immediate risk. Such bleeding as may occur can be readily checked, for all the parts are fully exposed; and freedom of respiration may be secured by the preliminary performance of tracheotomy; if, indeed, this operation have not previously been rendered necessary.

A good illustration of the success attending this method is afforded by the case of a girl, thirteen years of age, under my care some years since in Guy's Hospital. Tracheotomy had been performed four years previously on account of the urgent dyspnœa from which she then suffered. On laryngoscopical examination, masses of warty growths were distinctly seen. These were removed by the scissors after exposure of the laryngeal cavity by section through the thyroid cartilage, cricothyroid membrane, and other structures. Nitrate of silver was freely applied to the bleeding surfaces. The growths had occupied the whole cavity of the larynx. The divided parts were brought together. The patient made a speedy recovery, and the tracheotomy canula, which she had worn for four years, was removed ten days after the operation. I saw her the other day, three or four years after the operation. She was in good voice, and no appearance could be discovered of any recurrence of the growths.[2] In two other cases in which I have performed similar operations, the results have been so far equally satisfactory.

A remarkable case is recorded by Balassa, of Pesth. The patient, a young woman, twenty-one years of age, had suffered from more or less difficulty of breathing, and had been aphonic for more than two years. On laryngoscopical examination growths in the larynx were seen. Balassa laid open the larynx by section through the thyroid cartilage, and removed five portions of new growth. The patient made a good recovery, and her voice returned. Less than a year afterwards, she again lost her voice, and experienced increased difficulty in breathing. Balassa a second time opened her larynx through the thyroid cartilage in the situation of the old cicatrix. Three or four portions of new growth were removed. The patient

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[1] It is worthy of note, that the first recorded operation of this kind was performed in the year 1844, by Ehrmann, who, without the aid of the laryngoscope (not then in use), diagnosed the existence of growths in the larynx from the symptoms and the appearance of portions in the sputa. He was justly so confident of the correctness of his diagnosis, that he boldly opened the larynx by median section, found the growths, removed them, and cured his patient. Laryngotomie dans un cas de Polype du Larynx; Strasbourg, 1844. Also, op. cit.

[1] See especially the excellent treatise of Dr. Charles Planchon, Faits cliniques de Laryngotomie; Paris, 1869. In this treatise a large number of illustrative cases are given.

[2] See Guy's Hospital Reports, 3d series, vol. xii., p. 541.

again made a good recovery; and as the result, was altogether relieved of her dyspnœa, and regained her voice.[1]

In operations of this kind the thyroid cartilage and crico-thyroid membrane may be divided in the middle line probably with impunity. But it is desirable to avoid, if possible, cutting through or otherwise damaging the cricoid cartilage.

MM. Pratt and Follin have each succeeded in removing tumors from the larynx after having divided the thyrohyoid membrane and superficial structures by transverse incision.[2] The objections to this method, arising principally from the necessary section of the hyoidean muscles, as well as from the imperfect extent to which the cavity of the larynx is exposed, are sufficiently obvious.

[In certain cases direct access may be had to the neoplasm through an incision practised through the crico-thyroid membrane only.]

In the case of epitheliomatous and other cancerous growths, it would appear to be worse than useless to attempt removal, without first fully opening the larynx and exposing the whole extent of the morbid structures. Whether any such attempt is justifiable the circumstances of the case must decide. As a general rule tracheotomy becomes necessary sooner or later; and it is probable that when once the character of the malady is recognized the earlier the operation is performed the better.

[Extirpation of the entire larynx, or of a portion only, alone or in connection with other structures, has been practised successfully in cases of malignant growths, hopelessly involving the larynx. The majority of patients thus treated have died shortly after the operation; and it is doubtful whether, on the whole, any prolongation of life secured in exceptional cases, justifies the absolute sacrifice of existence entailed as the rule.]

NERVO-MUSCULAR AFFECTIONS OF THE LARYNX. NERVOUS OR FUNCTIONAL APHONIA. HYSTERICAL APHONIA. PHONIC PARALYSIS, ETC.

Nervous, or functional aphonia.—Numerous cases come under observation from time to time in which the voice is lost, and in which also, more or less difficulty in breathing may occasionally occur, although no visible defect or disease can be discovered in the larynx itself on the most careful and complete laryngoscopical inspection. It may be seen that the several parts do not act properly, and that is all. Why they do not so act cannot be satisfactorily made out. Sometimes when the patient tries to utter a sound the glottis may be seen to remain widely open, and no sound is produced. Sometimes one of the vocal cords appears to come into proper position, the other remaining motionless, and apparently paralyzed. Sometimes the vocal cords seem to approximate naturally at the commencement of the attempt to speak, and then separate without vibrating, as the air from the lungs is forced against them. Other odd phenomena may be observed by the aid of the laryngoscope.

Alluding to cases of this kind, Sir Benjamin Brodie states[1] (and his statements are supported by general experience and observation):—

> "This affection takes place suddenly, continues often for many months, even for one or two years, and then disappears as suddenly as it began. A patient thus affected may, when under the influence of strong mental emotion, find herself speaking in her natural voice, when for some time before she had spoken only in a whisper. Her recovery may be permanent, or she may relapse into her former condition. And again, this affection is not unfrequently met with in the male sex, especially in those of the clerical profession, probably because they often lead very sedentary lives, and also because they are called upon to speak in public in a tone raised above the ordinary standard."

Cases of the kind under discussion are nowadays commonly classed as examples of some so-called "hysterical affection of the larynx," although in many cases no other indications of hysteria are present. There can be no doubt but that in a very large proportion of instances the sufferers are either delicate young women, or highly sensitive "nervous" subjects of the other sex. At the same time it must be admitted that the true pathology and proper explanation of the affection are at present altogether wanting. Türck[2] and Gerhardt[3] on the Continent, and Mackenzie[4] in this country have of late especially attempted to give precision and definiteness to our ideas respecting the observed phenomena. They have also contributed somewhat to our knowledge of the determining causes of the affection, and the treatment that should be adopted when it is fully established.

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[1] Wiener medizinische Wochenschrift, November, 1868, quoted by Planchon. Op. cit., pp. 62 and 79.

[2] Pratt, Gazette des Hôpitaux, 1857. Follin, Archives générales, fév., 1867. Quoted by Planchon. Op. cit.

[1] Lectures on Certain Local Nervous Affections, p. 51.

[2] Op. cit., p. 430 et seq.

[3] Virchow's Archiv, vol. xxi.

[4] On Hoarseness and Loss of Voice in Relation to Nervo-Muscular Affections of the Larynx. London, 1868. See, also, Lagarde, De l'Aphonie nerveuse, Paris, 1865; and Krishaber, op. cit.

Sometimes the aphonia comes on as the result of exposure to cold after extra exertion of the voice. In such case, as suggested by Gerhardt, it may be to some extent analogous to the facial paralysis due to *coup de vent*. Sometimes it appears to be simply the effect of fatigue and incapability for renewed effort. Sometimes it remains after an attack of "sore throat" has altogether passed off; and in such case it may be the effect of indisposition, as it were, on the part of the muscles to resume those natural functions, from the performance of which they have been temporarily restrained by reflex sensibility. Sometimes, again, the determining cause may be mental emotion, from the sudden effect of which the nervo-muscular apparatus of the larynx may have been unable to recover itself. But much more frequently the explanation remains altogether undiscovered.

The affection now under consideration must be carefully distinguished from those forms of laryngeal paralysis with aphonia or hoarseness which are due to the pressure of tumors, aneurism, etc., upon the motor nerves of the larynx.

Treatment.—In some cases, and almost always in such as appear to depend simply upon local indisposition to exertion resulting from the effects of exposure to cold, fatigue, etc., recovery takes place naturally after a certain period of rest. But in many cases, and most constantly, perhaps, in such as are most obscure in their origin, the aphonia may remain persistent during weeks, months, or even years; and then, either as the result of some accidental circumstance, or as the effect of treatment, the voice may be either suddenly restored or gradually recovered. Constitutional treatment of the kind indicated by the general condition of the patient is often beneficial. But in a very large proportion of cases, some local stimulus—some "shake up" as it were—is necessary in order to set the nervo-muscular apparatus in action. Such local stimulus may be supplied in various ways.

In some cases the introduction of the laryngeal speculum, together with all the attendant formalities, is all that is required. Türck appears to have been the first to notice this "method of cure" of aphonia.[1] Trousseau and Krishaber refer to several instances.[1] Three have come under my own observation. One of these may be worth mentioning, inasmuch as it affords an excellent illustration of the manner in which in cases of this kind the voice may sometimes be suddenly regained.

A young lady, about nineteen years of age, was brought to me by her friends, who appeared most anxious about her condition, believing that some very serious disease existed. I was informed that the patient had entirely lost her voice for more than six months, and that all sorts of treatment had been tried, but with no good effect, etc. After a great deal of persuasion, and very many abortive attempts, I at last succeeded in putting the laryngeal speculum into position. I then, in a matter of course tone, requested the patient to say "*Ah, ah.*" Pushing away my hand, she immediately and impatiently exclaimed, in fair natural voice, "How can I, with that thing in my throat?" And then she added, "Oh, dear! I've spoken!" It is almost needless to add that the cure was complete. But supposing that it had happened that some special method of treatment had been in process of application at the moment, what a marvellous cure this would have been!

In some cases the inhalation of strong stimulating or irritating vapors, as those of ammonia or chlorine solutions, proves efficacious; in others the application of solutions of nitrate of silver or sulphate of copper by means of the sponge, probang, or brush, is followed by restoration of the voice. This method of treatment found especial favor with Trousseau, who records many cases illustrative of the good results obtained.[2] It is not improbable that in some cases equally good results might be obtained by the introduction of an *unmedicated* sponge or brush.

Another method of treatment especially relied on by Mackenzie consists in the direct galvanization of the vocal cords. This can be most easily and perfectly accomplished by means of Mackenzie's laryngeal galvanizer or electrode. There can be no doubt of the efficacy of this method. But—without any idea or intention of impugning for one moment the genuineness of the numerous examples from time to time published, in which cases of aphonia of long standing have been stated to have been cured by single, or by a few successive "applications of galvanism to the vocal cords"—it may nevertheless be asserted that the application of galvanism possesses no *specific* virtues in such cases as those under consideration. It simply affords a convenient and very effective method of giving the necessary "fillip" to the nervo-muscular apparatus. Equally good results have been obtained by passing the interrupted current of an electromagnetic battery through the back of the tongue.

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[1] See Allg. Wien. med. Zeitung, Feb. 21, 1860. Also Clinical Researches on Diseases of the Larynx, by Dr. Türck. Lond., 1862, p. 49.

[1] Trousseau, Clinique médicale, tom. i., p. 585. Krishaber, op. cit.

[2] Clinique médicale. Op. cit., tom. i., p. 579 et seq.

The method of treatment most recently advocated consists in manipulating (that is pinching and pressing backwards) the larynx; and many cases are recorded illustrating its efficacy.[1]

In conclusion, it may, I believe, be stated without fear of contradiction that the one thing especially necessary is, if possible, to surprise or startle the larynx into proper activity, and it matters comparatively little by what means this effect is accomplished. It must be borne in mind that in these affections there is no perceptible organic disintegration or wasting of the tissues. They appear to be sufficiently exercised for purposes of nutrition during their ordinary respiratory movements, which, as a rule, are carried on normally and without interruption.

Idiopathic atrophy of the muscles of the larynx and *muscular atrophy as the result of disease* are very rare affections. The examples that have at present come under investigation are so few that no satisfactory conclusions can be deduced.[2] It may be well, however, to bear in mind that such cases may from time to time present themselves.

In every case of aphonia, hoarseness, or other alteration of the voice, in which on laryngoscopical inspection one vocal cord only is found to be more or less completely paralyzed, and in which, at the same time, the parts generally are natural in appearance, search should be made for some cause of pressure upon, or interference with, the motor nerves of the affected side of the larynx. If the vocal cord rest motionless during attempted vocalization, attention should be especially directed to the recurrent nerve. If, however, the vocal cord is adducted and abducted more or less normally, but is not duly rendered tense, it may be that the superior laryngeal nerve, or rather its cricothyroid branch, is interfered with. Paralysis of the left vocal cord not infrequently indicates the existence of an aneurism of the arch of the aorta, or of some intrathoracic tumor.

SPASM OF THE LARYNX. SPASM OF THE GLOTTIS.

Spasm of the larynx, attended by the most alarming and sometimes fatal dyspnœa, may arise from various different causes. Many such causes have been already discussed in the preceding pages. Others may depend upon the effects of injuries, or the introduction of foreign bodies into the air-passages (see Vol. I. pp. 695–704 et seq.). Others again may depend upon the irritation produced by the pressure exerted upon the laryngeal nerves by aneurisms or tumors, whether they be "new growths" or simple enlargements of some natural organs, as the thyroid body, lymphatic glands, etc., and whether situated in the neck, or within the thorax. Intrathoracic tumors pressing upon the trachea or bronchi by some reflex nervous influence, and hysteria, tetanus, and certain cerebral affections in some manner altogether inexplicable, may also give rise to spasm of the larynx.

However difficult it may sometimes be to ascertain the cause, the symptoms of this formidable affection are always unmistakable.

Treatment.—If the spasm does not very quickly and very completely subside under simple treatment—and even in absence of all satisfactory explanation of the cause of the attack—tracheotomy should be performed without hesitation. There is far more danger in waiting too long than in operating too soon: and whatever the result, the conscientious surgeon may always feel assured that it is better to have made an unnecessary incision into the windpipe than to have allowed his patient to die for want of one.

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[1] See H. K. Oliver, M.D., in the American Journal of Medical Sciences, April, 1870.

[2] See Türck, op. cit., p. 203. Mackenzie, On Hoarseness, etc. Op. cit., p. 71.

DISEASES OF THE THYROID GLAND.

By Holmes Coote, Esq.

Revised by J. Solis Cohen, M.D.

The thyroid gland, one of the vascular bodies without ducts, consists of two lateral lobes, connected by an isthmus, which crosses in front of the three upper rings of the trachea. Hyrtl affirms that he has met with instances of complete congenital absence of the isthmus; and in aged subjects it is sometimes so far absorbed as to be scarcely distinguishable, the two halves of the gland appearing to be united only by areolar tissue. The proportion of the gland to the entire body diminishes with age. In new-born infants it is 1:300; at the end of the first month it is 1:1200; in adults it falls to 1:1800.[1] It is supplied by four, and sometimes by five, large arteries, branches of the carotid and subclavian trunks; the fifth artery, when it exists, lying in the mesial line of the trachea. The organ lies, moreover, in close contiguity to the great vessels and nerves of the neck.

Few surgeons believe that the entire thyroid gland has ever been successfully extirpated, although cases are so related by Desault, Roux, Gooch, Vogel, Theden, Hedenus, and others.

[In the United States, there is no doubt upon this point, albeit the profession are not generally prepared to endorse the operation under the circumstances in which it is most frequently performed. Not to be invidious, the names of the two Warrens of Boston, are especially associated with the operation, which has been successfully performed in many other portions of the country likewise.]

Dr. Hedenus speaks of six successful cases of removal. The operation, as recorded by himself, is as follows:—An incision was made from the os hyoides to the top of the sternum, and the skin reflected from each side to the extent of two inches. The sterno-hyoid and thyroid muscles, which were adherent to the tumor, were cut through in consequence of the hemorrhage following an attempt made to reflect them. He next separated the swelling above and below from the sterno-cleido-mastoid and omohyoid muscles, and also from the jugular vein and carotid artery (to which it was closely adherent), until he freed it as far as the point where the thyroid arteries originate. He then tied the superior and inferior thyroid arteries close to the tumor, and, on account of the free anastomosis, applied to each vessel two ligatures, and divided it in the interspace. The more deeply the dissection now extended, the more hazardous did it appear. Every four or five lines he was obliged to tie two or three arteries; a proceeding which was effected with great difficulty. After most cautiously dissecting to the base of the tumor, which was attached to the thyroid cartilage and the three upper rings of the trachea, he met with so many arteries, for the most part as large as the radial or ulnar, that in order to prevent further loss of blood, he decided to tie the base of the tumor, and to cut away all beyond the ligature. He accordingly first passed a needle, armed with ligatures, through the base of the tumor, and tied the ends; and next passed another ligature round the entire base, and removed as much as he thought proper. Some local applications, of no importance, were applied. During convalescence hemorrhage occurred, which was arrested by sprinkling the wound with gum-arabic. On the eighth day the ligatures came away. The patient ultimately recovered, and left the hospital well![1] These proceedings are scarcely considered admissible in modern surgery.

[Thyroiditis.

Acute inflammation of the thyroid gland is rare. It may occur even after unusual exposure to inclemency of weather, and even by extension of inflammatory processes from intra-laryngeal inflammations, such as occasionally accompany the degeneration of neoplasms. The symptoms comprise local swelling, and the usual evidences of inflammatory action. Resolution may occur, or abscess follow according to circumstances. It is also possible, as in one case under the reviser's care, that the dyspnœa induced by the tumefaction, may be sufficient to demand the prompt performance of tracheotomy and the introduction of the canula.

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[1] Hyrtl, Topog. Anat., b. i., p. 357.

[1] Gräfe's Journal, b. ii., p. 237.

The treatment is that ordinarily pursued for acute external inflammations.]

[BRONCHOCELE.]

The most frequent affection of the thyroid body is chronic enlargement, or hypertrophy, to which the term "bronchocele" is commonly applied. But under this head are included several morbid changes, all allied to one another in being developments of the natural component tissues of the organ.

A simple bronchocele consists in a uniform enlargement of the thyroid body in all its parts. The texture of the gland is healthy, except that it is coarser than that of a thyroid gland of ordinary size. Very frequently numerous cysts of one or two lines in diameter are found filled with a viscid fluid, or some, fewer in number and of larger size, partitioned and filled with a thin watery or bloody fluid, and scattered irregularly through its substance. As the enlargement proceeds, it may surround and compress the trachea and lower part of the larynx. [Severe dyspnœa is sometimes the result of compression. The involution of the trachea is recognizable, at times, on larygoscopic inspection. Tracheotomy is admissible in these instances, provided a canula can be inserted below or beyond the point of compression. In some instances, the operation is practised right through the gland.] A case is recorded by the late Mr. Howship, in which the jugular vein passed through the substance of the gland, and the patient suffered greatly from congestion of the head. The two lobes are rarely equally increased in size, the right being more commonly the larger: sometimes, it is said, the middle lobe, or pyramid, is principally affected. In this country [and in America] bronchocele is more common in women than in men. Cases occur in which young girls, from seventeen to twenty-four years of age, are subject to considerable enlargement of the thyroid body at each menstrual period; the swelling subsiding as that function subsides. [A similar condition is not infrequent during successive pregnancies.] I had under my care a young lady, in whom this thyroid enlargement became permanent, after the abrupt cessation of menstruation, caused by her being exposed to cold and wet during a stormy passage at sea. Mr. White Cooper has observed that in persons subject to this affection the eyes are often more than usually prominent. When of moderate size, the disease can be easily recognized, both by its position and by its following the movements of the trachea and œsophagus. It rises if the patient be directed to swallow. But when of larger size it may be known as being unlike anything else. It may be raised with every pulsation of the carotid artery, or hang down in front of the chest, so that it cannot be concealed by any sort of clothing.

In the severer forms bronchocele or goître is endemic. It prevails in Derbyshire, Nottingham, and the chalky parts of England; in the valleys of the Alps, Apennines, and Pyrenees. Postiglione remarks, that in Savoy, Switzerland, the Tyrol, and Carinthia, there are villages in which all the inhabitants, without exception, have these swellings.[1] The cause commonly assigned, namely the use of melted snow, or of water impregnated with calcareous or earthy particles, is unsatisfactory. Capt. Alexander Gerard, in his account of Korrawur, in the Himalayas, says, "although the Korrawurrees can get nothing but snow for some months in the year, they are not so subject to goître as the people who live in the damp grounds in the forest at the foot of the hills, where there can never be any snow-water. The water which flows from the hills of lias, forming the Asiatic side of the Dardanelles, is impregnated with lime; but yet during a residence of many months I did not notice the prevalence of goître." This idea has been successfully refuted by Alibert; and Foderé has explained how the disease cannot be referred to the use of any particular kind of food. Dr. Guggenbühl, the founder of the Cretin Hospital, remarks that both cretinismus and goître, which may exist either conjointly or separately, prevail in deep valleys, where the air stagnates, and the population, scanty in numbers, becomes deteriorated by frequent intermarriage. Cases of goître and idiocy removed to an elevated position, and properly nurtured, are first made to thrive bodily, and then are susceptible of mental improvement; and he particularly relates the case of a cretin child, who after having passed a life of apparently complete insensibility to external objects, gave suddenly the first indication of aroused consciousness, after proper treatment, by exclaiming, "Die Sonne!" (the sun), as the light of day fell on the spot where he was seated. Humboldt says that persons afflicted with bronchocele are met with in the lower course of the Magdalena River, from Honda to the conflux of the Cauca, in the upper part of its course, between Neiva and Honda, and on the high country of Bogota, six thousand feet above the bed of the river. The first of these three regions is a thick forest, while the second and third present a soil destitute of vegetation; the first and third are extremely damp, the second is peculiarly dry; in the second and third the winds are impetuous, in the first the air is stagnant. To these striking differences we will add those relative to temperature. In the first and second regions the thermometer keeps up all the year between 71° and 73° F.; in the third it ranges between 37° and 62° F. The waters drunk by the inhabitants of Maraquita, Honda, and Santa Fé de Bogota, where bronchoceles occur, are not those of snow, but issue from rocks of granite, freestone, and lime. The temperature of the waters of Santa Fé and Mompox, drunk by those who have this disease, varies from nine to ten degrees. Bronchoceles are the most hideous at Maraquita, where the springs, which flow over granite, are, according to Humboldt's experiments, chemically more pure than those of Honda or Bogota, and where the climate is much less sultry than upon the banks of the Magdalena River.[1]

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[1] Memoria sulla Natura del Gozzo, p. 22.

Dr. John Webster has favored me with some manuscript notes bearing upon this subject. He says that, according to information collected from reliable sources, there are 500,000 goîtrous persons in France. Some localities in that country are very remarkable for the large number so designated. For example, in a town of Lorraine, having recently 736 inhabitants, there were recognized 164 affected with goître, of whom 143 were females. Of the 164 goîtreux, comprising both sexes, 105 lived in houses having a northern exposure, while only 59 inhabited dwellings fronting the south, and thus enjoying more sunshine than the others. At Rosieux, also in Lorraine, it is reported that every indigent female is goîtrous. In the arrondissement of Schalstadt, situated in the Lower Rhine department, 658 goîtreux were lately registered. A still more remarkable instance of the frequency of the disease occurs at St. Aubin, near Elbœuf, on the banks of the Seine, not far from Rouen, where one female in every 16 of the total population has goître more or less developed. Other places in France might be named where the affection is very prevalent.

In Piedmont and Savoy, especially the latter, goitre is very rife. By an official report, continues Dr. Webster, published a few years ago, there were 18,462 simple goîtreux, besides 3909 cretins. Various mountainous districts in Europe are afflicted with this complaint, which, however, always disappears before civilization. It becomes rare as persons are better clothed and fed, and are not compelled to intermarry. Prior to 1818, goître was very common in the Swiss canton of Valais, and particularly in several secluded valleys near Martigny. In that year, from the bursting of a lake high up in the mountains, a valley not far from that town was completely devastated; houses, trees, cattle, and people being carried away by the flood. However frequent in this part was the prevalence of both goître and cretinism before the event. it was remarked that subsequently it nearly entirely disappeared, and the reason seemed the following. Before the great inundation, the soil of the valley was always wet, marshy, and unproductive. By the overflowing of the lake a mètre of good vegetable mould was brought down from the higher regions; the natives were obliged to exert themselves in the cultivation, whereby their physical status was much ameliorated, and the supply of food materially augmented.

At Caneles, near the Cordilleras, in North Mexico, many of the inhabitants are grievously affected. Authorities state that half of those employed in the mines are goîtrous, though generally only on one side of the neck. It is affirmed that children born of such parents are frequently idiots, or deaf and dumb.

In the treatment of bronchocele we should be particular to put the patient under circumstances favorable to recovery. In females, the menstrual function generally requires regulation; and a low damp situation should, where possible, be changed for a more airy spot. Blisters have been applied, and kept open; frictions have been recommended; the application of emplastrum ammoniaci cum hydrargyro, electricity, etc., but without much effect.

The remedy most relied on at the present day is iodine, which was first given in the form of burnt sponge; and is now employed both internally and locally, in the different forms admitted into the pharmacopœia. The iodide of potassium may be administered in doses of two or five grains, or even more, three times a day. If more than three grains are given at the commencement, the medicine is often removed in its excess by the secretion of the kidneys. In large doses it is apt to excite salivation. and to irritate the stomach. Iodine was discovered in 1813, by Courtois, manufacturer of saltpetre in Paris; but Dr. Coindet was the first to introduce it into medical practice for the cure of bronchocele. Shortly after its efficacy had been established, Dr. Fyfe, of Edinburgh, discovered the presence of iodine in burnt sponge.

[The reviser has had considerable success in treating goitre of recent origin, by local applications of a saturated solution of iodoform in ether, chloroform or collodion. The collodion solution possesses the advantage of exercising an equable compression upon the exterior of the gland, which appears to be additionally salutary. When the volatile ether or chloroform evaporates, a well-distributed layer of iodoform remains, a portion of which is undoubtedly absorbed through the skin, and thus exercises its resolvent powers. The applications are usually repeated daily, with occasional intermissions, whenever the skin becomes too tender for such frequent repetition.

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[1] Humboldt, in Journ. de Physiologie, par Majendie, tom. iv., p. 116.

Appropriate constitutional treatment is likewise instituted, iodoform being often substituted for the iodides more generally resorted to.]

Cases of enlargement of the thyroid body, demanding the application of ligatures to the nutrient arteries, must be considered exceptional, and modern surgery somewhat avoids the operation. In a case recorded by Sir W. Blizard, the patient died from the effects of hospital gangrene;[1] but a case reported by Walther, of Landshut, was successful.[2] The superior thyroid arteries were successfully tied by Mr. Coates, of Salisbury.[3] Mr. Skey observes:[4] "While on the subject of tying arteries in the region of the neck, I have referred to the operation of tying the superior thyroid artery as performed by Sir W. Blizard, by Mr. Earle, and others. It is an operation the performance of which is perfectly justifiable, and, as I can testify, is attended with marked diminution of the enlarged structure, if this be the object to be attained: but the relations of the inferior thyroid arteries are so much more complicated, and the artery itself lies so deeply imbedded in the structures of the neck, that I conceive its exposure without danger to be almost impossible." Thus the question stands; the general feeling being by no means favorable towards the operation.

Dr. Murnay speaks highly of the treatment of bronchocele by strychnia. The first case in which he used it was that of a lady aged thirty, who had had good health up to four years previously, when the catamenia became irregular and were attended with great pain on each periodic return. She assigned as the cause of the thyroid tumor great distress of mind and disappointment. When Dr. Murnay saw her, the disease was of six months' duration; the right lobe of the thyroid gland was fully as big as a turkey's egg, extending laterally so as to press on the right carotid artery and jugular vein; a strong pulsation was felt in the tumor, and a purring thrill was communicated to the hand. She had no palpitation of the heart; but she complained of headache, and of a buzzing noise in the right ear; she imagined there was a slight enlargement of the right eye, and that she felt a sensation of fulness in it. The tumor at times impeded deglutition, and occasionally her breathing also. After a fair trial of the usual remedies, strychnia was administered in the dose of $\frac{1}{16}$ gr. three times a day. At the end of a fortnight there was great improvement, and ultimately the gland regained its normal size. The second case was that of a housemaid, the enlargement having lasted twelve months, and both lobes being involved. There was great palpitation of the heart, pulse 130, eyes prominent, catamenia irregular, tongue large and flabby, and coated with a yellow fur in the centre; bowels constipated, acting only once a week. In this case the medicine was ordered in a fluid form; one grain was dissolved in seven drachms of water and one of dilute sulphuric acid. She was to commence with five minims three times a day, and to increase to twenty. On the tenth day of taking the medicine, a great flow of menstrual discharge came on, lasted a few days, and returned in a week. The treatment was continued, and soon after the gland began to shrink. The third case was that of a young lady aged fifteen, in which at the time of the report the symptoms were progressing favorably.[1]

Mr. Hey, of York, has treated bronchocele successfully by seton. The patient was a young lady twenty-one years of age, who had suffered from bronchocele from her earliest infancy. Mr. Hey passed a skein of silk through one half of the gland, commencing at the upper part, in the median line, and, taking as nearly as possible a semicircular direction, brought it out at the corresponding point below; thus embracing half the tumor, at a depth of from three-quarters to one inch, so that the seton was fairly established in the substance of the gland. The patient did not seem to suffer pain, and there was no hemorrhage of consequence. For the first five weeks no material change took place; the discharge was slight, and it was found necessary to use savine ointment. In the course of the sixth week the patient suffered from a feverish attack; on the third or fourth night after the fever she was seized with a cough of most distressing character; she became delirious, with brown and dry tongue; this condition lasted forty-eight hours. The seton began to discharge a thin, dirty-looking, and most offensive matter, which relieved the irritation about the windpipe, and the delirium subsided. By degrees the discharge became purulent, and ultimately all signs of thyroid enlargement disappeared.[2] Mr. Hey remarks that this operation was known a century ago;

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[1] Burns, Surgical Anatomy of the Head and Neck, p. 202.

[2] Neue Heilart des Kropfes, p. 25; 1817.

[3] Med. and Chir. Trans., vol. x., p. 312.

[4] Operative Surgery, p. 545; see edit. 1858.

[1] Dublin Hosp. Gaz., June 1, 1860.

[2] Provincial Medical and Surgical Journal, Sept. 10, 1849.

but Dr. Quadri, of Naples, revived it, and practised it to a considerable extent about the years 1817-18. Mr. Copland Hutchinson tried it in 1819.[1] Mr. T. A. Thompson and others have followed, with generally favorable results. Still the nature of the symptoms here recorded point clearly to chances of risk, and a cautious practitioner should well weigh the necessity of operating at all.

[Injections of tincture of iodine, solutions of carbolic acid, tincture of the chloride of iron, solutions of ergot, and other agents, are sometimes practised with success, in hypertrophic goître as in the cystic variety. Interstitial injections are not devoid of danger, and are sometimes productive of death by entrance of air into the venous circulation, or by thrombosis and embolism.]

M. E. Collin, médecin-major de 1re classe, records the particulars of a remarkable attack of acute goître in the garrison at Briançon during the year 1860. The 87th regiment of the line arrived at Briançon on October 22, 1859. During 1860 it represented the garrison of the place, comprising an effective force of 1062 men. During the year the regiment sent to the infirmary 55 cases of goître. Of these 55, there were 53 acute cases contracted at the town. The attack nearly always commenced after six months' residence. The five months most fertile in the generation of goître were from May to September. M. Collin has called attention several times to the rapidity with which this disease may manifest itself. In certain subjects much predisposed, eight days sufficed for its formation.

Of the 53 goîtres, there were 8 median, 2 unilateral, 27 bilateral, and 16 three-lobed. Of the 27 bilateral goîtres, 20 were on the right side; and of the 16 three-lobed, 10 were also on the right. This latter point confirms the opinion of Alibert, and is supported by nearly all the specimens in the Hunterian Museum. No remedies were found of any avail; and M. Collin very properly recommended either a rapid change in the regiment, or an entire change in the locality of the station. He adds that during winter the ground is constantly covered with snow; and that during that season there is no proper place for exercise.[2]

Instances are upon record in which bronchocele has proved fatal, by compression of the trachea. One of the latest cases is recorded by Dr. Dickinson.[3] The patient was a tailor aged seventeen. For some time he had had palpitation of the heart, and about eighteen months before his death he noticed a swelling in the position of the isthmus of the thyroid gland. The swelling extended laterally, so as to occupy the sides of the neck, and he then began to have fits of shortness of breath. In the attacks of dyspnœa the air passed with a hissing sound, as if from constriction of the larynx. He was admitted into St. George's Hospital, where he one night died suffocated before tracheotomy could be performed. Upon examination after death, it was found that the compression of the trachea, which was very great, commenced at about two inches below the vocal cords, and extended downwards for two or three inches. A preparation, exhibiting in a striking manner the enlarged thyroid gland surrounding and compressing the trachea and the lower part of the larynx, is preserved in the Museum of St. Bartholomew's Hospital. Mr. Macwhinnie[1] relates the case of a patient aged seventeen, attended by Mr. M'Crea of Islington, where death ensued under symptoms similar to those of strangulation.

The enlargement of the thyroid gland, which has been noticed not uncommonly in pregnancy, and quite independently of the conditions usually considered to be favorable to the production of goître, is not usually dangerous; but M. Guillot notices two cases under his own care, which show that it may prove perilous to life itself.

A lady æt. thirty, in easy circumstances and of excellent health and constitution, found her neck, during a first pregnancy, become the seat of a slowly-increasing enlargement. During a second pregnancy, in 1835, it increased again and became troublesome. In 1858 M. Guillot saw her with M. Trousseau, as the respiration was much impeded. A few days afterwards, the patient being nearly asphyxiated, laryngotomy was performed with immediate relief, but death ensued in two days.

The second case was that of a young woman aged twenty-nine, the mother of two children. Both respiration and voice were embarrassed, and she was liable to suffocative paroxysms. These symptoms had come on gradually from the time of her first pregnancy. She was admitted into the Necker Hospital, where one of the paroxysms of dyspnœa terminated fatally. The thyroid gland had nearly acquired the size of a human brain; the tissue was healthy in appearance, and there were numerous small cysts scattered throughout its substance.[2] The author regards the disease as one of the manifestations of the excessive production of fibrin during pregnancy.

Dr. Herbert Davies exhibited at the Pathological Society of London, May 21, 1849, both the thyroid and the thymus glands much hypertrophied, taken from a boy aged sixteen, who died suddenly from a spasmodic affection of the larynx. He had noticed the swelling of the neck about the age of fifteen; the enlargement increased rapidly about four months previous to his death, and it produced a sensation as if he were "breathing through a sponge." On examination, the thyroid, thymus, and bronchial glands were found much enlarged; in the last there was a deposit of tubercle. On microscopic examination of the thyroid gland, it was found to consist of the usual vesicles, containing a fluid in which were a large number of corpuscles, the majority of which were smaller than the blood-disks.

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[1] Med.-Chir. Trans., vol. xi., p. 235.

[2] Recueil des Mémoires de Méd. militaire, juillet, 1861.

[3] Trans. of Path. Society of London, vol. xii., p. 229.

[1] Lancet, July 13, 1861.

[2] Archiv. gén. de Méd., t. xvi., 1860.

Pulsating or exophthalmic bronchocele.—A peculiar variety of bronchocele, distinct from the ordinary goître, and to which various names have been applied, may be here noticed; though, as it forms but one link in a long chain of morbid symptoms, it would be out of place to describe fully the disease, of which it forms but a part, among the affections of the thyroid gland. It is almost invariably associated with palpitation of the heart and a prominent condition of the eyeballs, and hence have arisen the various names under which these combined symptoms have been described: as "goître exophthalmique," "affection of the heart and thyroid gland," "anæmic exophthalmos," "maladie de Graves," "maladie de Basedow,"—according to the theory of the origin of the disease which each writer adopts, or the name of the authors who were supposed to have first described it. It occurs more commonly in females than in males, though it is by no means confined to the former sex. The characters of the disease are very well marked, and are thus enumerated. The first symptoms are usually palpitation of the heart and habitually rapid pulse, with other signs of nervous debility; and these are followed at a longer or shorter interval by enlargement and pulsation of the thyroid gland, with violent beatings of the carotid arteries. After these symptoms have existed for some time,—and in some cases it is said, before the enlargement of the thyroid gland,—an unnatural prominence of the eyeballs begins to be perceptible; and this gives to the patient a wild or startled, and occasionally almost maniacal expression. In a case related by Dr. Stokes,[1] "the tumefaction continued to increase, until the globes of the eyes appeared to protrude from the orbits, looking downwards and forwards, and exhibiting a zone of white sclerotic round the entire of the cornea of at least two lines in breadth. The lids could only be half closed; and the appearance of this lady during sleep, with those great brilliant eyes yet open, can never be effaced from my memory."[1]

The enlargement of the thyroid gland is peculiar. In one of Dr. Begbie's cases, which may be taken as a type, it was soft, smooth, and elastic, and of equal character throughout, presenting the form of hypertrophied gland, and had rapidly developed itself to its present size—that of three or four times the magnitude of the gland in health; but it was subject to remarkable variations in this respect, according to the state of mind, rest, or palpitation. It appeared to be highly vascular, and conveyed to the touch the sensation of an erectile tumor.[2] There is commonly also a purring thrill to be felt by the fingers, and a loud and sometimes musical bruit to be heard through the stethoscope. Indeed, some years ago a case, in which there existed this condition of the gland, was mistaken for an aneurism, and (though fortunately for the patient the nature of the disease was discovered in time) a day had been appointed for tying the carotid artery.[3]

Together with the pulsation of the thyroid gland and of its dilated main arteries, the carotids beat violently, and often with a double pulsation and loud bruit; and the patient complains of distressing sensations of suffocation, hammering in the head, vertigo, tinnitus aurium, etc. In a case recorded by Sir H. Marsh, the patient could feel the whizzing in her neck, and it formed one of her most distressing symptoms. Sometimes also the pulse in other arteries than the carotid is unusually jerking and large. In one of Dr. Stokes's cases the patient complained of violent pulsation of the abdominal aorta; and in a case which Dr. C. J. B. Williams mentioned at the Med.-Chir. Society,[4] there was enlargement of the arteries of the forehead, face, and neck. In many cases, however, a marked difference in the pulsation of the carotids and of the radial arteries has been noticed; that of the former being violent and jerking, that of the latter comparatively feeble.[1] Sometimes large veins can be seen ramifying over the enlarged thyroid gland; and the external jugular and other veins of the neck are at the same time much distended. The heart beats quickly, and upon the least excitement violently; and at its base and in the large arteries a bellows-sound is almost always to be heard through a stethoscope. The pulse, indeed, habitually rapid, often reaches 130 to 140 beats in a minute.[2]

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[1] Diseases of the Heart and Aorta, 1854, p. 285.

[1] Dr. Stokes supposes that the prominence of the eyeballs depends on an increase in the vitreous and aqueous humors; but the majority of observers, probably more correctly, think that the prominence is caused by some morbid condition of the structures situated in the orbit, behind the globe. What this morbid state is, remains, however, still uncertain. Effusion of serum, increase of post-ocular fat and cellular tissue, congestion of the orbital veins, etc., have been assigned by different writers as causes of the protrusion.

[2] Contributions to Practical Medicine, 1862, p. 121.

[3] Diseases of the Heart and Aorta, by Dr. Stokes, p. 279.

[4] Lancet, Dec. 8, 1860.

From the foregoing account, it will be readily seen that this disease is very different from ordinary goître; and indeed its diagnosis from this or from any other malady is not difficult. These are the chief points of distinction from common bronchocele: 1. The size of the tumor formed by the enlarged gland varies considerably with the general condition of the patient as to rest or excitement, and their effect on the heart's action; 2. The appearance of the disease is independent of endemic influences, so powerful in the production of ordinary goître; 3. The tumor rarely becomes large enough to cause any great deformity, though Dr. Stokes says he has seen two cases in which this was produced in a considerable degree; 4. Dr. Graves says that it differs also from goître in its size becoming stationary just at that period of growth at which the last-named disease usually increases more rapidly; 5. The purring thrill and loud murmur in the tumor, as well as the other general symptoms—the palpitation, the prominent eyeballs, the jerking carotids, etc.—will be abundantly sufficient for confirming the diagnosis.

Notwithstanding the apparent urgency of the symptoms, this disease is very rarely fatal, unless accompanied with organic disease of the heart, or some other serious complication. Comparatively few opportunities of examining the condition of the thyroid gland, after death, have therefore occurred; and these have been for the most part in those who died from some attendant malady, rather than from the peculiar assemblage of morbid symptoms which by themselves make up the disease.

The appearances, therefore, which have been observed in the heart, etc., after death, in the few cases on record, must not be taken as representing those which ordinarily exist; but must be checked by the observation of the far larger number of cases in which complete recovery has ensued on proper treatment. The appearances, however, which more immediately concern us—those in the thyroid gland, namely—are probably characteristic.

In 1841, Sir H. Marsh communicated to the Pathological Society of Dublin an account of a patient who suffered from this disease, and who died from gangrene of the extremities, preceded by erysipelas and anasarca. The thyroid gland was irregularly lobulated on the surface, the lobules or cysts containing a quantity of clear fluid. The right internal jugular vein was much dilated, and measured, when emptied by puncture, an inch and a half across. One of the enlarged lobes of the thyroid body lay over the carotid artery. Both auricles, especially the left, were much dilated. The left ventricle was somewhat dilated and hypertrophied. The auriculo-ventricular valves, on both sides, had thickened margins; the disease apparently proceeding from depositions of fatty granular matter under the membrane. The right valves were more affected than the left.[1] In another case, that of a woman who died from apoplexy, and who, at the time of her death, suffered from this disease, the thyroid arteries, which during life could be felt pulsating strongly, were found greatly enlarged and remarkably tortuous. The thyroid gland was enlarged. The left ventricle was greatly hypertrophied, and its cavity much dilated.[2] In a case of Dr. Begbie's, the thyroid gland was enlarged to three times its normal bulk from hypertrophy. The heart was somewhat enlarged, from slight dilatation of the right cavities. The walls of the right auricle were very thin. The valves were healthy. Various other organs were more or less diseased.[3] In another case recorded by the same author, and in which the patient died from heart-disease, general dropsy, etc., "the sterno-hyoid and sterno-thyroid muscles were much thinner and broader than natural, from being stretched over the thyroid body, which was of large size. The external jugular veins were normal; the internal jugulars were large; the left one, when slit open, measured an inch and a half across at a level with the cricoid cartilage. The thyroid body was of large size, but was not weighed; its weight, however, might be computed at four or five times the natural weight. Each lateral lobe measured an inch and a half in breadth, and was of a corresponding thickness. This great size was not partial, but general; and although the isthmus was comparatively larger than the lateral lobes, there was complete symmetry of both sides. It was of a dusky-red color, smooth, and well-defined, and slightly irregular on its anterior surface; but still retained the natural convex and semilunar form of the organ, when in a state of health.[4] Several other organs were diseased.

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[1] Dr. Stokes, op. cit.; Dr. J. O. Fletcher, Brit. Med. Journal, May 23, 1863.

[2] Begbie, op. cit., p. 130.

[1] Stokes, op. cit., p. 290.

[2] Ibid. p. 291.

[3] Op. cit., p. 141.

[4] Op. cit., p. 146.

The prognosis in those cases—the most frequent—in which there exist no signs of grave organic disease in the heart or other organs is very favorable, though a long time often passes before the characteristic features of the disease entirely disappear. In favorable cases, the heart, becoming less excitable, again recovers its former steady and healthy action ; and an improvement in the state of this organ seems to be usually the first step towards recovery.[1] Then follow recession of the eyeballs within the orbit, and gradually lessening of the thyroid tumor, with loss of its pulsation, and, it may be, hardening of its substance ;[2] and, accompanying these are improvement in the general health, and commonly, after a longer or shorter time, perfect recovery.

The immediate causes of the disease are not very well defined ; but they appear to include almost any of those circumstances which lead to general ill-health and anæmia, although in some cases the patients are tolerably healthy-looking or even plethoric. Dr. Begbie, however, thinks that even in these there is probably an unhealthy condition of the blood ; and adds, "I have seen no instance of the disease in which the general and physical signs of anæmia were not more or less completely developed, and no case in which an adequate cause of that condition was not furnished in its history ; nor any one in which a marked mitigation, or complete removal of the symptoms, has not taken place under a plan of treatment calculated to overcome the blood disorder."[3] Amenorrhœa, long-continued hemorrhage from piles, bilious diarrhœa, want of rest, and many other similar causes, have been assigned in different cases. Dr. Stokes says, "In young women, mental anxiety and the effect of terror may produce it. I have known a remarkable instance of the latter cause inducing the disease in a lady who had previously been healthy." In a few cases the disease appears intimately associated with organic disease of the heart ; but this can be by no means considered essential, and the cardiac disease is supposed by many, when it exists, to follow rather than precede the symptoms which have been described, and to arise from long-continued functional disorder of the organ.

There has been almost as much difference of opinion concerning the nature of this disease as there has been agreement concerning its symptoms, prognosis, and treatment. Dr. Begbie thinks that the essence of the disease consists in a vitiated or impoverished condition of the blood, and that this condition, acting directly on the cardiac nerves, excites the heart and vessels to over-action ; that the anæmic palpitation thus produced is followed by the characteristic symptoms, and, if not removed, issues in organic change of the heart, in enlargement of the great vessels, in induration and structural degeneration of the thyroid gland, etc. Dr. Stokes supposes that the disease is a special form of cardiac neurosis, which may lead to organic disease, and that the nervous excitement is possibly propagated to the arteries of the neck, as he thinks that their pulsation is more than can be accounted for by the force of the heart. Prof. Laycock[1] thinks the symptoms are due to neurosis of the cerebro-spinal tract, or rather of several vaso-motor centres in the spinal cord. The bronchocele (which is essentially a dilatation of the vessels of the thyroid gland) he thinks is due to a lesion of a paralyzing kind of the trunk of the sympathetic. Dr. J. O. Fletcher is of opinion that we must look to the nervous system, and especially to the brain for the cause, and that the disease is "hyperneuria," induced by sleeplessness, anxiety, etc., impairing digestion and assimilation ; "secondarily interfering with the normal nutrition of the nerve-centres, causing a state of hyperneurosis with want of power, which induces imperfect secretion by some organs, and, as a necessary consequence of this, if long continued, causes organic changes."[2] Dr. Handfield Jones : that the fundamental malady is debility, especially of the nervous system, which, by affecting various vaso-motor nerves, gives rise to the several symptoms.[3] M. Trousseau : that it is a neurosis, having its proximate cause in a change of the vaso-motor apparatus, and that the anæmia follows, rather than precedes, the characteristic symptoms.[4]

The proper treatment is very definitely pointed out by the causes and symptoms of the disease. To remove those conditions (if they still exist) which appear to have been important elements in the first production of the disease, as hemorrhage, over-exertion of mind or body, etc.—to allay the excessive action and irritability of the heart by digitalis, morphia, hyoscyamus, and similar drugs—to improve the impoverished or vitiated blood by tonics, especially iron—to place the patient in favorable conditions, as far as is possible, for good air and perfect rest,—are the obvious and most important general methods of treatment, the details of which must be decided separately for each case. Iodine, whether taken internally, or applied to the surface of the swollen thyroid gland, appears to be by itself of very little use. [Iodoform internally, as first pointed out, I believe, by Dr. Carpenter, of Pottsville,[1] is often peculiarly efficacious in the treatment of this form of goître; apparently by some influence on the nervous system, rather than by its resolvent properties.] The application of ice appears in some cases to be very beneficial. It does not often happen that immediate danger is caused by the pressure of the enlarged thyroid body on the trachea; but M. Trousseau relates such a case; and the patient, a boy about 14 years old, was apparently saved from suffocation, or, at least, from undergoing tracheotomy, by venesection, by the application of ice to the neck, and by the administration internally of digitalis.[2] Three weeks afterwards he could walk more than two miles, and, when M. Trousseau last saw him, he had almost completely recovered.

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[1] Dr. Fletcher, Dr. Stokes, etc., op. cit.

[2] Dr. Bullar, Med.-Chir. Trans., vol. xliv., p. 40 ; Dr. Stokes, op. cit., p. 288.

[3] Op. cit., p. 170.

[1] Brit. and For. Med.-Chir. Rev., Jan., 1864.

[2] Op. cit., p. 539.

[3] Proceedings of Med.-Chir. Soc., 1861.

[4] Clinique méd. de l'Hôtel-Dieu, pp. 644, 645.

Dr. Graves ingeniously suggests that the globus hystericus, so commonly attendant upon nervous palpitation, and so often referred by the patient to the situation of the thyroid gland, may arise from swelling of this body and pressure on the trachea; and that it is not, therefore, a purely nervous sensation.

Acute inflammation of the thyroid body is rare. Sir T. Watson remarks that this gland "does not seem very prone to inflame; and probably Dr. Copland is right in his opinion that inflammation occurs spontaneously in this organ in scrofulous persons only."[3] I have met with one instance of the disease.

An old woman, incurably insane, died in Bethlehem Hospital, December 22, 1846. Before death, for some days, she had experienced great difficulty in swallowing, and had objected to take food. On examination of the body, it was found that the skullcap was thicker and heavier than natural, and the brain was congested with blood. There was diffused purulent infiltration for one inch in length, and half an inch in breadth, affecting the cellular tissue of the œsophagus just where it winds round to get in front of the descending aorta. The left lobe of the thyroid body was much enlarged, and occupied by cysts of various sizes. There was purulent infiltration diffused throughout the whole organ, but more extensive on the left side. The cysts contained flakes of thick fibrin mixed with fetid fluid. The œsophagus was contracted in that spot around which the pus had been effused. There was no other morbid appearance.

Mr. Turner, of Kensington, has related some cases of *suppurating cysts* of the thyroid body, treated by free incision; in one case the cyst-wall came away, and, reasoning from this experience, he proposed, as a method of treatment, to obliterate the cysts formed in this gland by inflammation artificially excited in the following manner: The skin covering the cysts was gradually destroyed by repeated applications of caustic potash rubbed over a space equal in size to a florin; then a blunt-pointed director was introduced, and pushed about so as to excite vascular action, in consequence of which suppuration ensued, and the cavity slowly contracted. He put this method into practice in two cases, the particulars of which are related in the Medical Times and Gazette, Jan. 20, 1855. We must accord merit to this surgeon for the care with which he conducted his cases.

In 1841, the late Mr. Vincent had under his care, in St. Bartholomew's Hospital, a woman, 48 years old, with a tumor in front of the neck as large as the head of a child of two years. The tumor contained fluid, which was twice withdrawn with a trocar. The fluid first evacuated resembled serum, but coagulated spontaneously; on the second occasion it was mixed with blood. After the second operation, the cyst inflamed, and discharged grumous and sanious pus; but it also enlarged quickly, and the patient died unexpectedly from suffocation. On examination after death, it was found that nearly the whole of the right lobe of the thyroid body was occupied by a cyst, the walls of which were two lines in thickness; the cavity was full of lymph, pus, and blood; the sudden death was due to a discharge of a great part of its contents into the pharynx and larynx, through an ulcerated aperture into the former.[1]

In reference to this subject Flajani says:—

"I was once called to assist a gentleman, 40 years of age, brought to death's door by a bleeding, which arose from the application of caustic to the fore part of the neck. As tourniquets, bandages, etc., proved quite ineffectual, it was indispensable to make pressure on the part with the finger of an assistant for twenty-four hours, ere the hemorrhage could be stopped; a copious suppuration ensued, and it was three months before the part healed. I was likewise present," says he, "at the opening of a similar but larger swelling in the same situation, the patient being an elderly person, who had suffered from the disease for several years. The incision caused the evacuation of a small quan-

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[[1] Trans. Med. Soc. State of Penna., 1878.]

[2] Op. cit., p. 631.

[3] Lect. Practice of Physic, vol. i., p. 756, 1845.

[1] Museum of St. Bartholomew's Hospital, ser. xxii., No. 16.

tity of serum contained in the cellular membrane; but the following day the tumor inflamed, the difficulty of respiration increased, and for some days the patient was in great danger. At length suppuration was established, followed by destruction of a great deal of the cellular membrane and several sinuses. The patient lost his life; and on examination of the body, the lungs were found tuberculated; an effect of the impediment to the circulation of the blood through the smaller vessels of those organs."[1]

I have succeeded in producing the complete obliteration of a thyroid cyst, with corresponding diminution in the size of the swelling of the gland, in a young married woman, healthy, and of temperate habits, by means of the injection of iodine in the usual proportions of one drachm of the tincture to five of water. But whoever undertakes such an operation should bear in mind the numerous complications which may await him; as well as the fact that in some instances the hemorrhage has been so severe as to demand the application of a ligature to the carotid artery.

Two cases of *cancer* of the thyroid body have been recorded by Dr. v. Franque.[2] Both patients were between forty and fifty years of age, and in both instances there was found further morbid deposit in various organs. In the left lung of the first case there were noticed old tubercle in the upper lobe, and cancerous deposit in the other parts. In the second case the viscera were very generally affected.

The same disease has been described by Mr. Cæsar Hawkins in the Medical Gazette, 1843. The first case, seen in 1837, might perhaps be somewhat doubtful, from want of post-mortem examination; but four other cases were verified. The disease commenced between the ages of forty-five and sixty. In one instance the parts adjacent to the pharynx and œsophagus were infiltrated by cancer. There was a large ulcer on the œsophagus, and the right internal jugular vein was closely adherent to the tumor. I have seen a similar case in St. Bartholomew's Hospital.

In such cases none but palliative remedies are of any avail; but the pain and distress in breathing may be greatly allayed by the employment of the hypodermic injection of morphine.

In conclusion, I may repeat the words of Rokitansky: "If we except serous, fibrous, cartilaginous, and bone-like productions, all other new formations in the thyroid gland are extremely rare. Tubercle is scarcely ever seen, and cancer in its medullary form is in the highest degree exceptional."[1]

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[1] Flajani, Collezione d' Osserv., t. iii., p. 283, 8vo., Roma, 1802.

[2] Deutsche Klin., vol. xxxix., 1856.

[1] Pathol. Anat., vol. iii., p. 151.

APNŒA (ASPHYXIA).

By George Harley, M.D.

Revised by J. Solis Cohen, M.D.

From Suffocation, Hanging, Drowning, Chloroform, Poisonous Gases, etc.

As the chief characteristic of the mode of dying about to be considered is the continuance of the heart's action after the cessation of the respiratory process, in order to be logical as well as philosophical in the treatment of the subject it is necessary to abandon the old and familiar word Asphyxia, which, in its etymological sense, signifies an absence of pulse (ἀ, *not;* σφύζω, *I beat*) and employ in its stead the more suitable term Apnœa (ἀ, *not;* πνέω, *I breathe*). Even the word Apnœa fails clearly to convey to the mind the true proximate cause of death; for in certain cases of suffocation animal life is extinguished, although there be no impediment to the physical part of the respiratory process, and in these circumstances it is not the absence of the respiratory act, but of the proper respiratory medium (oxygen), which determines the death of the individual. As the word apnœa is, however, applicable to the majority of cases, we prefer to retain it rather than coin a new one, which, in its turn, might be found equally inadequate to the explanation of phenomena which advancing science may afterwards reveal.

So long as animal life continues, the function of respiration knows of no intermission. By day and by night, sleeping and waking, the lungs are ever performing their allotted labor of inhaling fresh and expelling effete air.

The term "apnœa" therefore clearly defines the great truth that without respiration there is no life: man's earliest declaration of independent existence being his first respiratory effort; his seal to the abdication of life, his last expiratory act.

Few are aware how little the respiratory function is under their own control. At the first glance many might imagine that respiration is, to some extent, a semi-voluntary process, for they can temporarily arrest it at pleasure. If, however, the time men are able to cease respiring be exactly calculated, no one can fail to be astonished at its extreme brevity. Not one in a hundred can cease breathing for a single minute without suffering great discomfort; and still fewer can hold their breath for two entire minutes without yielding to an involuntary and irresistible respiratory effort. The numerous stories heard and read of persons voluntarily holding their breath for five or more minutes are simply fables. Farther on it shall even be made apparent that the numerous reports of successful cases of resuscitation after prolonged submersion—such as half an hour, for example—are pure impossibilities, originating in imperfectly observed data. Such statements would never have been promulgated had their authors for a moment considered how frequently repeated and uninterrupted the acts of respiration are. The number of respirations is alone a sufficient proof of their necessity. If, for example, the average number of respirations be taken as low as eighteen in a minute, which is somewhat under one in four seconds, it is evident that the gases essential to the continuance of organic life are renewed one thousand and eighty times in in single hour—figures which are of themselves sufficient to indicate how perilous must be even a very temporary cessation of the respiratory function. Shortly, however, other reasons will be adduced for disbelieving the statements referred to. Meanwhile it may be proper to consider the

Symptoms of Apnœa.

The first symptoms that manifest themselves when a healthy person is deprived of air are feelings of thoracic fulness and discomfort, which gradually, but rapidly, assume the form of an intense oppression. To the latter symptom is soon superadded an uncontrollable desire to breathe, which is immediately followed by violent respiratory efforts. The respiratory efforts are at first short and recur in rapid succession. They soon become deep, forcible, and prolonged, with a gradually-widening interval between them until just before they entirely cease, when they again diminish in force and duration. During this period, which, for the sake of convenience, may be termed that of respiratory movement, certain cerebral symptoms present themselves in somewhat of the following order: In the earlier part, the patient feels a sensation of fulness in the head and giddiness; experiences singing in the ears, and has flashes of light dancing before his eyes. To these, it is said by persons who have been rescued from impending suffocation, succeed pleasing, almost voluptuous, dreams, which however, soon fade away, and give place to insensibility and unconsciousness, which, in their turn, are speedily followed by convulsions and coma.

As regards the circulatory system, it is found that at first the heart's action is accelerated, partly perhaps on account of the patient's struggles for breath. This condition is but transitory; for in the space of a very few seconds its action becomes slow, labored, and feeble, till the pulse at length ceases to be perceptible at the wrist. The heart is, however, still pulsating, and the throb may be detected by the aid of the stethoscope: the action gradually becomes less and less distinct, till it entirely ceases at a period within ten minutes after the first interruption to the respiratory process. The period that elapses between the last respiratory effort and the cessation of the heart's action may be calculated to vary from two to four minutes.

The appearance of the patient during the time just described undergoes a marked change. There is an extremely anxious expression of countenance, blueness of the lips, projection of the eyeballs, distension of the vessels of the face, head, and neck, frothy mucus, occasionally sanguineous, about the mouth, and involuntary passage of urine and feces, sometimes even an emission of semen with or without erection. All of these symptoms are modified, and supervene with more or less rapidity, according to the mode in which the apnœa has been produced. Although apnœa may be induced in a great variety of different ways, each of which presents its own peculiarity, it is unnecessary at present to dwell upon the subject, the diagnosis of the case being in general attended with no difficulty, from the fact that its history clearly explains the symptoms. It has, however, happened that the medical attendant has been purposely misled into an error in diagnosis by the relatives of the patient, who, in their desire to protect the honor of the family, have occasionally not hesitated to trifle with the life of one of its members. It is therefore of importance to call attention to the danger, which a practitioner occasionally runs in such cases, of mistaking the cause of the symptoms, and thereby falling into an error in treatment. This can scarcely be more forcibly done than by briefly relating the case recorded by Mr. Thomas Stainthrope, which strikingly illustrates the truth of the remark.

On one occasion, Mr. Stainthrope was suddenly called after midnight to see a clergyman. On arrival he found the gentleman in bed, unable to speak, insensible, and presenting the symptoms of apoplexy. The relations heard the remarks of the medical attendant, listened to the line of treatment suggested, and assisted in its performance, without giving the slightest hint as to the true cause of the symptoms, or making any allusion to the fact that the patient had, a few minutes before, been found suspended by the neck to the top of his bed. Mr. Stainthrope, in the belief that the case was one of apoplexy, opened the veins of both arms, and extracted three pints of blood before any improvement in the symptoms took place. This was followed by other treatment considered applicable to the case; but it was not until ten hours had elapsed that the gentleman was able to answer questions; and no wonder, seeing that if the medical attendant had been honestly informed of the cause of his patient's symptoms, he might probably, with a little assistance to respiration by artificial means, have restored him in as many minutes. The gentleman recovered.[1]

Apnœa arising from disease may give origin to precisely the same train of symptoms as that supervening upon an accidental mechanical obstruction to the respiratory process; the only difference being that the symptoms in the former case usually progress very slowly, as for example, in cases of death from apnœa caused by œdema of the glottis; from the trachea becoming blocked up with a false membrane, as in diphtheria and croup; from the accumulation of mucus, as in bronchitis; from insufficient healthy pulmonary tissues remaining to admit of the blood becoming arterialized, as in pneumonia; and from compression of the lungs from effusion, as in double pleurisy.

In all these cases there is one remarkable circumstance observable, namely, that the lividity and congestion of the face are almost, if not quite, as apparent as in cases arising from a ligature round the neck, by which the descent of the blood through the jugular veins is interrupted. The same remark is equally applicable to cases in which the disease is external to the trachea; as, for example, in cervical tumors, aneurism, hypertrophied thymus, etc., which produce apnœa by their pressure on the trachea.

The explanation of this is simple enough. First, the face and lips are livid from the arteries conveying venous instead of arterial blood; and secondly, they are congested on account of the circulation being arrested in the lungs, which causes the right side of the heart and the large veins opening into it to be engorged; and these, in their turn, produce congestion in the vessels opening into them.

POST-MORTEM APPEARANCES.

The external appearances presented by individuals in cases of death by apnœa vary according to the manner in which it has been induced, as well as with the period that has elapsed between the examination and the extinction of life. If the examination be delayed for twelve hours, for example, the signs presented by the body differ but very slightly, if at all, from those frequently found in persons that have died from other causes. Positive evidence, indeed, can only be obtained in such cases by an internal inspection, and even that must be carefully made, otherwise the cause of the apnœa may escape detection. This remark is specially applicable to cases of accidental and intentional apnœa.

If the body is seen within three or four hours after death, its external surface will be found to present numerous discolorations. The lips are blue, and oftentimes covered with frothy mucus, which occasionally presents a slightly sanguineous appearance. It ought not to be forgotten that frothy, even sanguineous, mucus may be found about the mouth in other cases of sudden death besides that arising from apnœa. This is the case in epilepsy; in heart-disease; and on the very day of writing these lines we saw it in a marked degree in a case of concussion of the brain. The driver of a pianoforte van was thrown violently from his seat against a lamp-post; and on his being brought to University College Hospital, the slightly tinged froth around the mouth and about his nostrils was specially observed. He had been dead about fifteen or twenty minutes. The tongue is often swollen and livid, and not unfrequently shows marks of the teeth upon it. This is particularly noticeable in those cases in which convulsion has preceded death. The eyelids are half open and the pupils dilated. The countenance is generally placid, the skin of the face usually pallid, or if discolored at all, possessing a faintly livid transparency. In cases of death from drowning, the skin has now and then been observed to present the appearance denominated cutis anserina; but this is by no means a common occurrence.

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[1] Lancet, Oct. 1, 1859.

In apnœa from the external application of mechanical means, evidences of the mode by which death has been induced generally remain visible for some hours. There may be abrasion, ecchymosis, or laceration at the injured parts. There may be the mark of a cord or of fingers upon the neck. The hyoid bone may be fractured, the cartilages of the larynx dislocated; and various other evidences of mechanical injuries, according to the manner in which the apnœa has been induced.

On the other hand, it must not be forgotten that death may arise from mechanical means, and not a trace of its nature be visible to the eye. This has frequently happened in cases of smothering and plugging of the fauces and windpipe. In such cases, therefore, the existence of the apnœa can only be detected by an internal inspection.

Even in cases of death by hanging, if the body be cut down immediately after the extinction of life, the mark of the cord or rope entirely disappears within a very few minutes, so that a person examining the body for the first time half an hour or more after death, would fail to discover any traces on the neck indicative of the manner by which life was extinguished. This arises from the fact that where there has been no excessive application of violence the mark of the cord is due (contrary to the common idea) to the post-mortem constriction; so true, indeed, is this, that if a human body be suspended by a cord immediately after death from ordinary disease, and allowed to hang for more than half an hour, the mark of the cord becomes permanently visible. These facts ought never to be forgotten, in post-mortem examinations of medico-legal import.

Moreover, the post-mortem appearances in cases of poisoning by the substances included under the head of toxic gases, vary as much as the symptoms themselves. In some they are even totally opposed. Thus, for example, while the muscular tissues and organs of an animal poisoned with sulphuretted hydrogen are of an intensely dirty-black color, those of an animal that has succumbed to the effects of pure carbonic oxide are of the most beautiful vermilion hue. So it can be readily imagined that, even if we felt inclined, it would be impossible for us, in the short space at our disposal, to give an outline of the symptoms and post-mortem appearances produced by all the substances that might be included under this heading.

As regards the much vexed question of *rigor mortis*, it may be said that it usually sets in early; and this is particularly the case after drowning in cold water, when a state of semi-freezing has been frequently observed instantly to succeed, if not actually to usher in, death. So firmly are substances occasionally grasped in the clenched hand of the drowned, that they are only to be extracted from it by the application of great force. Cases are recorded where the finger-bones have been actually fractured during the forcible opening of the hand.

Condition of the brain.—The cerebral vessels have by most authors been particularly noted as being engorged with dark venous-colored blood. Great doubts have recently been thrown on the value of this sign, however, by Ackermann, who states that from the results of experiments on animals, conducted according to Professor Donders's method of rendering visible the condition of the circulation in the brain during life, it appears that death by suffocation is always connected with an exsanguine state of the cerebral vessels; the appearances of hyperæmia, so often observed, being merely the result of the post-mortem mechanical distribution of the blood. The appearances of cerebral anæmia, the author states, are even distinguishable in cases where the animal has been strangled with a cord round its neck, and the head kept somewhat lower than its body. The anæmic condition of the brain is gradually assumed after death if the head be not kept lower than the rest of the body, and it only attains to its maximum an hour or two after death. If these assertions be correct, they clearly point to the necessity of carefully taking into consideration the position of the body after death, before drawing any conclusions from the state of the cerebral vessels.

Ackermann goes so far as to to say that the condition of cerebral anæmia is equally observable after death from compression of the chest, inhalation of chloroform, and injections of water into the lungs. The results of these experiments seem to explain why cerebral anæmia has been so frequently noted in cases of death by apnœa. It must not be forgotten that extravasations of blood under the arachnoid have been occasionally found in drowned persons. These were probably due to the injuries sustained by the head in falling from a height. Mere concussion with the surface of the water has been known to produce it; and it is common enough in persons who have come into violent contact with the bottom, or with substances floating on the water, while diving. In a case of death from the inhalation of chlorine gas, it is stated that the gas was afterwards detected in the fluid of the ventricles of the brain.

Condition of the heart and vessels.—Particular attention has been paid to the condition of the heart and great vessels in cases of death by apnœa. It is usual to find the right side of the organ, both auricle and ventricle, as well as the large vessels attached thereto, highly engorged with dark-colored blood. The left side of the heart, on the other hand, is in the majority of cases found empty; or if it contains blood, the blood is of the same venous hue as that found occupying the right side of the organ. The blood throughout the whole body, indeed, is of a similar dark tint. Some state that it presents the additional peculiarity of being fluid; but this is far from being always the case. The portal system is greatly engorged. The liver, spleen, and kidneys specially partake of the venous congestion. It may indeed be asserted, in general terms, that in death by apnœa all the internal organs are more or less engorged with dark blood. Most authors have stated that the lungs are particularly so; but although we have had our attention specially directed to this point for many years past, and enjoyed several opportunities of being present at the autopsy of persons who have perished by apnœa, we are forced to admit that this is not so invariably the case as we had been led to expect.

There being no more blood in a person killed by apnœa than in one who has died from any other cause, it is easy to see that there cannot possibly be a general engorgement of the whole vascular system. If one part of the body is particularly congested, another must be proportionally anæmic. The venous system is full of blood because the arterial is empty; and the simple reasons are—1st, that the pulsations of the heart and vessels continue after the respiration and consequent circulation in the lungs is stopped; and 2dly, the resilience of the arterial coats prevents the return of the blood into them from the capillaries. Again, as regards the congestion of the internal organs. If it be very marked, there is a corresponding pallor of the external surface. This is specially noticeable in persons drowned during the winter months, and is due to the cold causing constriction of the cutaneous vessels and driving the blood inwards.

Condition of the respiratory system.—In cases of death by hanging, strangulation, and suffocation, the lungs present no characteristic appearance; unless it be that, on opening the chest, their tissue does not collapse in the usual manner, in those exceptional cases where the exit of the air by the trachea is prevented by constriction or plugging of the windpipe. In cases of death from the inhalation of sulphuretted hydrogen gas, the pulmonary tissue is blackened, and in those from carbonic oxide gas of a fine vermilion hue.

It sometimes happens when the apnœa is due to the inhalation of toxic vapors, such as chloroform, that there are one or more small extravasations of blood found in different parts of the pulmonary tissue. Sometimes these hemorrhagic effusions are quite superficial, at others deep seated. It is more particularly in cases of death by drowning that the lungs may be said to present characteristic appearances, and to these we shall now make special allusion.

Some say that water never penetrates the lungs, in consequence of spasm of the glottis being induced as soon as the fluid comes in contact with the opening to the air-passages. Others again, with equal confidence, assert that not only water, but any foreign substance, such as mud, duck-weed, and chaff, which may accidentally chance to be floating in it, are carried into the lungs. Our personal experience, as well as that of the Royal Medical and Chirurgical Society's Committee,[1] entirely negative the former, and support the latter, statement.

Into the lungs of every animal, without a single exception, experimented upon by the committee, the fluid in which the animal was immersed freely entered. The extraordinary force by which substances are drawn into the lungs in cases of drowning was estimated by the committee, and found to be equal to the raising of a column of mercury four inches.[2] When dogs were drowned in plaster-of-Paris, on examining the lungs after death the white plaster could easily be detected in the minute bronchial tubes. Even in the lungs of guinea-pigs held upside down, with only the nose immersed sufficiently deep in mercury to prevent the possibility of the animal getting any air, globules of the metal were readily detected in the minute tubes, thereby proving that this weak animal's respiratory efforts were capable of drawing the mercury the distance of one or two inches in spite of gravitation. The lungs of animals drowned in pure water, when examined immediately after death, were found by the committee to be saturated and sodden with water to such an extent that they pitted on pressure, felt doughy to the touch, were exceedingly heavy, and incapable of collapsing. The air-tubes were choked up with a sanious foam, which consisted of blood, water, and mucus, churned up with the air in the lungs by the respiratory efforts of the drowning animal. On section of the pulmonary tissue, frothy water stained with blood poured out at every point.

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[1] As it will frequently be necessary, in the course of this article, to refer to the results obtained by the committee, it may, perhaps, be as well to mention that the gentlemen composing it were: C. J. B. Williams, W. S. Kirkes, George Harley, J. B. Sanderson, C. E. Brown-Séquard, H. Hyde Salter, W. S. Savory, and E. H. Sieveking, Hon. Sec. Med.-Chir. Soc. (ex-officio). The report appeared in the forty-fifth volume of the Society's Transactions, 1862.

[2] Vide report, Med.-Chir. Trans., vol. xlv., p. 455.

How can this fact be reconciled with the statement so often made, that no water is to be found in the human lungs after death by drowning? We have ourselves failed to detect water in the respiratory organs of a young woman, aged 23, who committed suicide by drowning. The lungs, when examined twenty-four hours after death, crepitated readily on pressure, except in the most depending portions, to which the blood and water, if there was any, had gravitated. The failure in detecting water in this case, however, did not excite the least surprise, notwithstanding our being in possession of the above-mentioned data; for we were at the same time acquainted with the important fact of the powerful absorbing power of the pulmonary tissue. It is almost impossible to say how much water may be taken into, and disappear by absorption from, the lungs during the act of drowning. It must be remembered that the extinction of life in cases of submersion is not due to water entering the lungs, but solely to the absence of air. If air be allowed to enter the lungs at the same time as the water, the animal suffers little or no inconvenience from the presence of the latter in the pulmonary tissue. One can wash out the lungs by a continuous stream of water, and the animal yet live. It may even be all the better for the species of pulmonary irrigation. It is only during the first few minutes that water induces much irritation, and causes the animal to struggle and cough. The irritation soon subsides; and if the water is allowed steadily and slowly to flow into the lungs, no apparent inconvenience arises. Even half-an-ounce may be suddenly thrown into them, and, after causing the animal to make one or two deep inspirations, entirely disappear. This may be repeated at intervals of a few seconds for at least half an hour, without in the slightest degree endangering life. All that is required to ensure success in this experiment is simply to allow of the admission of a sufficient quantity of air to keep up the arterialization of the blood.

We have inserted and firmly tied into the trachea of a large dog a long glass tube, to the upper end of which a glass funnel was attached, in order to enable the experimenter the more easily to pour in water; and while the animal was lying on its back, ounce after ounce of water has been thus introduced into the lungs, and from thence absorbed into its circulation, without producing any visible disturbance, except during the few seconds that the water in its transit blocked up the tube and prevented the entrance of air.

If water be, as has been already said, slowly poured into the lungs, and sufficient air at the same time admitted, thirty, forty, or fifty ounces may be easily introduced in as many minutes; and on killing the animal an hour or two afterwards, not a trace of the liquid be found in the pulmonary tissue; the lungs at the same time appearing none the worse for the experiment.

There cannot be any longer much question about water entering the lungs in cases of drowning; and its absence in post-mortem examination is due, in all probability, to its subsequent absorption. In cases of persons drowned in ponds, duck-weed and other matters floating on the water have frequently been found in the trachea and bronchi, and yet no liquid detected in the pulmonary tissue. We have observed that in an animal that has struggled much, and frequently got its nose to the surface for a sufficient length of time to inhale a little air, there is far less water found in the lungs than in one that has been from the first wholly submerged. This is precisely what happens with human beings, who, even in cases of suicide, generally struggle for some time, and thus succeed in obtaining occasional gasps of air, at last succumbing to the combined effects of exhaustion and suffocation. Again, it may happen that on removal from the water the body may be so placed as to admit of the exit of any fluid that may chance to be present in the trachea and lungs. These are points which will be more easily understood after having discussed the pathology of drowning, so that it will be better in the meanwhile to turn attention to the consideration of the

Physiology and Pathology of Apnœa.

In order to be philosophical as well as practical in the exposition of the physiology and pathology of this mode of death, it will be necessary to divide the various forms of death by apnœa into the four following classes, the subdivisions of which, for the sake of brevity, are best put in the shape of a skeleton diagram :—

Apnœa, 1st, from a mechanical impediment to the entrance of air into the lungs.

2d. From drowning.

3d. From the absence of oxygen in the respired gas.

4th. From the inhalation of a toxic vapor associated with an absence of oxygen.

Apnœa may arise from

- 1st, Mechanical impediment to the entrance of air into the lungs.
  - Accident.
    - External.
      - Pressure on the trunk preventing the expansion of the chest; throttling; garrotting; strangulation by a cord; hanging; smothering by covering the mouth and nostrils, imbedding the face in earth, feathers, wool, etc.; paralysis of the respiratory muscles from injury to the spinal cord, or to the base of the brain; or a double penetrating wound of the chest admitting air.
    - Internal.
      - Choking from a morsel of food or other substance blocking up the fauces; plugging of the trachea by a cherry-stone or other substance; constriction of the fauces and injury to the glottis from application of corrosive and irritating fluids.
  - Disease.
    - External.
      - Pressure on the trachea from an aneurism or other tumor.
    - Internal.
      - Œdema of the glottis; tumor on or about the vocal cords; false membrane blocking up the air-passages, as in diphtheria and croup; bursting of an abscess or aneurism into the trachea; double pneumonia or pleurisy; accumulation of mucus in the bronchial tubes; apoplexy at the base of the brain or in the medulla oblongata, causing paralysis of the pneumogastric nerve and of the respiratory muscles.
- 2d, Drowning . . . . . .
  - In any liquid of whatever nature —water, wine, beer, or brine.
- 3d, Absence of oxygen in the respired gases.
  - Inhalation of pure nitrogen, hydrogen, or any other innocuous gas.
- 4th, Inhalation of a toxic gas or vapor.
  - In which death is erroneously attributed to apnœa.
    - Carbonic acid, carbonic oxide, coal-gas, choke-damp, ammonia, chlorine, sulphuretted hydrogen, arseniuretted hydrogen, antimoniuretted hydrogen, sulphurous acid, nitrous acid, hydrocyanic acid, vapor of chloroform, ether, amylene, or any other volatile product.

Death from a mechanical impediment to the entrance of air into the lungs.—In many of the examples of death by apnœa cited in the above table, it is evident that it must occasionally happen that the death is accelerated by the direct action upon the body of the cause producing the apnœa. Thus, even in the first sub-class, which is specified as being due to mechanical obstruction to the entrance of air into the lungs, it can readily be imagined that the patient does not always succumb from pure apnœa. Fracture of the ribs, rupture of the liver, and many other injuries, may arise from pressure on the trunk, and thereby tend greatly to accelerate death. But there can be no doubt that in the majority of cases of suffocation arising from pressure on the thorax and abdomen preventing the expansion of the chest and consequent inhalation of air, apnœa is the immediate cause of death. For example, it would have been so in the case of the black athlete, who nearly lost his life in consequence of the shrinking of the plaster of Paris in which he was enveloped while having a cast of his body taken. The plaster shrank as soon as it began to set, and compressed the chest to such an extent that the poor man could neither breathe nor speak, and the extreme danger of his situation was only discovered just in time to rescue him from impending suffocation. In this case death would have been the result of apnœa.

Persons crushed in a crowd may die, in the same way, of pure apnœa, and even these accidentally buried beneath a fall of earth or stones, as well as such as are strangled with a cord, garrotted with the arm, or throttled with the hand; but in no one of these cases is pure apnœa of necessity the only cause of death. As a striking illustration, let us take death by hanging. It is known that, as a rule, the person is suffocated by the pressure of the rope on the trachea preventing the admission of air into the lungs. Occasionally it happens, however, especially in hanging at legal executions, where the body is allowed to fall from a distance with a sudden jerk, that the death is instantaneous, in consequence of dislocation or fracture of the vertebræ, with an accompanying lesion of the spinal cord. The contrary may likewise occur, and instead of death being more rapid, it may in reality be slower than in pure apnœa. This may arise from the position of the rope on the neck being such as to interfere with the circulation in the jugular veins, and thereby induce an artificial apoplexy, which, by reducing the necessity for oxygen, allows the life of the individual to be prolonged beyond the limit allotted to pure apnœa. This statement will be readily appreciated after the effects of anæsthesia in cases of drowning have been explained.

It is hence evident that if we wish to study the phenomena presented in cases of death by pure apnœa, arising from a mechanical impediment to the entrance of air into the lungs, and to recognize the order of their sequence, it will be necessary to turn our attention for a few minutes to its least complicated form; and this unfortunately can only be satisfactorily illustrated by reference to experiments on animals. We must therefore leave aside, for a time, the consideration of its effects upon the human being.

The Committee of the Royal Medical and Chirurgical Society has furnished the following important data:—

First, the duration of the respiratory movements.

Secondly, the duration of the heart's action.

Thirdly, the duration of the heart's action in relation to the duration of the respiratory movements.

The method of experimenting was as follows: The animal was secured on its back, and the trachea exposed by a single incision in the mesial line of the neck. A ligature having been passed round the windpipe, it was opened by a vertical cut, and a glass tube, as large as could be conveniently inserted, was passed into it for a short distance downwards, and firmy secured by the ligature. Through this tube, while patent, the animal breathed freely, but the supply of air could be at once completely cut off by inserting a tightly-fitting cork into the upper end of the tube. It was ascertained by separate experiments that the tube thus plugged with the cork was perfectly air-tight. From the result of nine experiments performed in this manner it was found—

First, that in the dog the average duration of the respiratory movements after the animal has been deprived of air is four minutes five seconds; the extremes being three minutes thirty seconds, and four minutes forty seconds.

Secondly, the average duration of the heart's action is seven minutes eleven seconds; the extremes being six minutes forty seconds, and seven minutes forty-five seconds.

Thirdly, the results of the experiments led to the belief that, on an average, the heart's action continues for three minutes fifteen seconds after the animal has ceased to make respiratory efforts; the extremes being two and four minutes respectively.

In the case of three domestic rabbits experimented upon, it was found that, on an average, they ceased to make respiratory efforts in three minutes twenty-five seconds; that their hearts' action stopped in seven minutes ten seconds; and consequently that the interval between the last respiratory effort and the cessation of the heart's action was three minutes forty-five seconds.

It will be here observed that there is no very marked difference either between the duration of the respiratory movements or of the heart's action in the powerfully-constituted dog and the weakly-constituted domestic rabbit. It appears, therefore, that in the absence of any positive reliable data regarding the absolute duration of the respiratory movements and of the heart's action in man in cases of death by uncomplicated apnœa, one may venture to assume that they do not differ very materially from those of the animals just cited.

The next point of importance to ascertain is the latest period at which recovery is possible after the simple deprivation of air. Here again the committee has furnished important data, which may be usefully turned to account in considering the subject of treatment in the case of the human being.

The result of the experiments led to the conclusion—1st, that a dog may be deprived of air during a period of three minutes fifty seconds, and afterwards recover without the application of artificial means; and 2dly, that a dog is not likely to recover if left to itself after having been deprived of air during a period of four minutes ten seconds. Other experiments tended also to confirm the above fact, viz., that in dogs the doubtful interval of recovery and death lies between three minutes fifty seconds, and four minutes ten seconds.

From the results obtained by the committee while engaged in ascertaining the exact period after the simple deprivation of air at which recovery is possible under natural circumstances without the aid of any artificial means of resuscitation, it was found possible to deduce the following conclusions, which most probably are as applicable to man as to the animals experimented upon by the committee.

1st. That a state of apnœa being maintained for a given time, the later the respiratory efforts are continued, *i. e.*, the shorter the interval between the last respiratory effort and the admission of air, the greater the chance of recovery.

2d. That air being admitted at a given time after the last respiratory effort, the earlier the respiratory efforts cease the greater the chance of recovery; for the earlier they cease, the shorter the interval between the establishment of, and the release from, the state of apnœa.

3d. In respect to the relation between recovery and the duration of the heart's action, it was found that under no circumstance did recovery ever occur when the heart's action, as indicated by a needle[1] inserted into the organ, had stopped.

Apnœa from submersion.—We have now to consider the second form of death by apnœa, viz., that by drowning. As will be immediately seen, it presents conditions differing widely from those met with in any of the forms of death just considered, arising from the mechanical obstruction to the entrance of air into the lungs.

First, as regards the length of time a person may be submerged and yet recover.

Before discussing this point in connection with the human being, it will be advisable, in order to place the subject in its clearest light, first to examine the results which have been obtained from experiments on animals, as they explain many of the phenomena occurring in man which have hitherto been regarded as obscure.

Having seen what the effects of simple apnœa are, we shall now proceed to quote the results of the experiments performed by the committee, which illustrate the effect of drowning.

1st. When a dog was kept under water only one minute, it recovered.

2d. When a dog was submerged one minute fifteen seconds, it also recovered.

3d. When a dog, treated precisely in the same manner, was submerged one minute thirty seconds, it died; and this was invariably the case, even when the animal was not only able to make spontaneous efforts at respiration, but actually capable of giving a cry after its removal from the water.

Thus, then, we are here furnished with the remarkable fact, that whereas in simple apnœa recovery is always possible after three minutes fifty seconds, only one and a half minute's complete submersion in water suffices to destroy life. To what is this extraordinary difference due?

In order to solve this question the committee placed two dogs under precisely similar circumstances, with the exception that in the one case the free access of water to the lungs was permitted, and in the other prevented. The following were the experiments:—

First. Two dogs of the same size were fastened to the same plank and submerged at the same moment, one of them having previously had its windpipe plugged in the usual way, and the other not. At the end of two minutes they were simultaneously removed from the water. The one that had the trachea plugged at once recovered; the other died.

Secondly. The above experiment was repeated, the dogs being kept under water four minutes. When removed from the water, the dog that had his trachea plugged got up in a few minutes comparatively well; while the other, though gasping when taken out, died.

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[1] The duration of the heart's action was conveniently ascertained by means of a long pin inserted through the thoracic walls into some part of the ventricles. So long as the heart continued to beat the pin moved, and its motions were thus recorded for some time after the cardiac sounds had ceased to be audible. The needle may be withdrawn and reinserted several times without producing any other result than slight temporary acceleration of the heart's action.

These experiments satisfactorily show that the difference between apnœa produced by plugging and that by drowning is not due to submersion, to depression of temperature, or to struggles, seeing that the two animals were placed under precisely similar conditions, with this most important exception, that in the one case a free passage of air out of the lungs, and of water into them, was permitted; in the other, the exit of air and the entrance of water were alike prevented.

There can be no doubt that both these circumstances are concerned in producing the difference in the results of the two experiments. Moreover, the condition of the lungs, as revealed by post-mortem examination, appeared to the committee to furnish a further proof that the shortness of the period of immersion, which proves necessarily fatal to an animal, is mainly due to the entrance of water, and the effects thereby produced.

On examining the lungs of the animals deprived of air by plugging the trachea, they were found simply congested; but in the animals drowned, not only was the congestion more intense, accompanied with ecchymosed points on the surface and in the substance of the lung, but the air-tubes were completely choked up with a sanious foam, consisting of blood, water, and mucus, churned up with the air in the lungs by the respiratory efforts of the animal. The lung-substance too was heavy, and saturated with water.

Since the conclusion of the labors of the committee, we have carried the inquiry a step further, and ascertained that the effects of the water extend beyond the mere pulmonary tissue. In some carefully-performed experiments, we found that in cases of drowning the blood in the left side of the heart contains much more water than that on the right; and when examined microscopically, the blood-corpuscles from the two sides of the heart present entirely different appearances. Thus, for example, we ascertained that while in the blood of the right auricle or ventricle the corpuscles may be nearly all serrated, in the watery blood from the left side of the organ it is not only frequently utterly impossible to detect a single serrated corpuscle, but in the latter blood, many of the cells have swollen up, burst, and allowed their coloring matter to escape, and stain the serum of a deep red color. In some cases we also noticed that occasionally, when there was scarcely a whole blood-corpuscle to be seen, the field of the microscope was occupied by an immense number of small bodies like escaped nuclei, and we are not yet quite certain that they were not nuclei, notwithstanding it was dog's blood we were examining, which is supposed to possess only non-nucleated blood-corpuscles. Although this peculiar effect of the water on the blood-corpuscles may have something to do, as we shall presently see, with secondary apnœa, we do not consider that it influences, to any marked degree, the rapid extinction of life in cases of complete submersion. The death in such cases is much too speedy to be thus accounted for. We shall shortly see that the difference in the time required to drown and to suffocate an animal must be due to an entirely different element, namely, the presence or absence of air in the lungs. That a moderate amount of air suffices to sustain life for some length of time is well illustrated, as regards the human being, in the case of sponge- and pearl-divers, who, through the influence of habit, are able to bear submersion for a period which would be exceedingly perilous to the non-habituated. Lefevre states that he has seen Navarino sponge-divers remain under water for nearly two minutes, their average time of submersion being about eighty seconds. Mr. Reynaldo, late Port-surgeon at Bombay, informs us that he has frequently timed the most expert divers in the Bombay harbor, and that some of them could sustain entire submersion for two and a half minutes. In order to accomplish this, however, they are forced to employ an artificial aid to the retention of the air in the chest. Immediately before diving they forcibly distend the lungs with air, and instantly afterwards slip over the nose a clip made of a bullock's horn, in order to prevent any involuntary expirations. The lips, being much more easily controlled than the nostrils, are left unprotected.

For the reasons given at pp. 91, 92, when treating in general terms of the effects of the introduction of water into the lungs, it cannot be said that the greater rapidity of death in submersion over simple apnœa depends on the deleterious action of the inspired water; and, as has just been shown, it is equally impossible to attribute it either to the struggling of the animal or to the external influence of the water on the frame. One is thus compelled to seek for another explanation of the phenomenon. It appears to our mind that the true explanation lies in the facts just alluded to, namely, that when the lungs are full of air, the escape of which is prevented, the animal obtains sufficient oxygen to support life for at least double the time it would do if they were entirely empty. Thus, for example, when the trachea of the animal is plugged, as in the experiments of the committee, not only is the entrance of water prevented, but the exit of air is stopped. So also in the case of the pearl divers: the clip on the nostrils acts the part of the plug in the trachea, and, by putting a restraint on involuntary respiration, enables the individual to retain in the lungs a quantity of air from which the blood can extract sufficient oxygen to prolong life within certain limits.

Dr. Sanderson, moreover, informs us that he has been able to demonstrate this fact by direct experiment, and that he finds that in animals the duration of life, up to a certain point, is in an exact ratio to the quantity of air confined in the chest.

When an animal is entirely submerged and fills its lungs with water, all, or nearly all, the air contained in the pulmonary vesicles at the moment of its submersion is expelled, and it is thereby placed in the most unfavorable circumstances for the prolongation of its life. The same thing occurs when an animal is confined in a jar of pure nitrogen gas. The air in the lungs is rapidly replaced by a gas incapable of supporting life, and the animal speedily perishes—much sooner than if the lungs were filled with air and the trachea plugged. These facts, as we shall presently find, are of the utmost value in connection with the subject of treatment; for, as will be seen, paradoxical as it may appear, the best way to preserve life, under certain circumstances, is to stop breathing.

Effects of syncope in cases of drowning.—The occurrence of syncope is said greatly to augment the chances of recovery in cases of submersion. And it does so, no doubt, within certain limits, for the same reason as anæsthesia does, namely, by reducing the number of respirations. It has, however, a still further advantage in temporarily arresting tissue-metamorphosis, and thereby reducing the necessity for oxygen. We cannot, however, believe that syncope is capable of prolonging life beyond a very few minutes, for the simple reason that the heart's action cannot be arrested for even a very brief space of time without inducing a fatal result. In a drowned animal, although the movements of respiration stop much sooner, half as soon again as in a strangled one, the heart's action continues for nearly the same length of time, namely, from seven to nine minutes; and in neither case is it possible to resuscitate the animal after the entire cessation of the heart's action.

It appears to us that the majority of persons have most erroneous notions regarding the duration of syncope in general, and syncope under water in particular. Many cases, where the patient is not submerged, are mistaken for syncope, which are not in reality such; both the respiration and the heart's action continuing, but so feebly as, in a cursory examination, to escape detection. We doubt very much, judging from what we know of the phenomena of the cardiac action (for, be it remembered, there is no direct evidence one way or another), if it is probable, or even possible, for the heart to resume its action after five minutes' entire cessation. This leads to the question, *How long may a human being be under water, and yet recover?* This entirely depends on the degree of the submersion. If a person be completely submerged, and the entrance of water to, and exit of air from, the lungs not prevented, we believe that recovery would be impossible after two minutes. On the other hand, if the air-passages were closed against the entrance of water, and the chest kept full of air, we see no reason for thinking that a human being would perish either more slowly, or more quickly, than a dog placed under similar circumstances—namely, in from four to five minutes.

The reason why some persons remain a long time in the water, and yet ultimately recover, is that they are never, or at least only for a very short part of the time, totally deprived of air. Every now and then their heads come to the surface, and they obtain an inspiration. Even if they can but gasp in a small quantity of air, and that too accompanied with water, they may be able to struggle on for a long time, as it is only the total deprivation of air that kills quickly. A person can exist for an hour on a very small quantity of air, if it be but frequently enough exchanged. This fact we see illustrated every day in the persons of patients suffering from pneumonia supervening on phthisis, who struggle on for hours with only a portion of their lungs capable of performing the functions of respiration. Then, again, as regards the damage done to the pulmonary tissue by the entrance of water, that, we have already seen, can at most be but very trifling, for the liquid is rapidly absorbed into the circulation from the pulmonary vesicles, and leaves scarcely a trace of its transit (see p. 91).

The effect of water upon the blood itself is much more marked; for, as was said at pp. 95, 96, it thins the vital fluid, and when in large quantity even destroys a number of the blood-corpuscles. When we consider, however, the very large amount of blood in an adult body, at least fifteen pounds, and the proportionally small amount of water taken in at a time, we can readily understand how it is that its effects are rendered apparent only in cases of complete submersion. In the case of dogs whose lungs have been irrigated with water, it is difficult to detect any deleterious action of the water upon the blood-corpuscles; and this probably arises from its rapid elimination preventing any visible injurious dilution of the vital fluid. Such an action it must, however, to some degree exert.

The effect of temperature on the rapidity of death in cases of drowning.—The temperature of the water influences to some extent the rapidity of the fatal result. If we take the normal temperature of the animal as the starting point, we find that death is more rapid as we descend towards the freezing, and ascend towards the boiling point. The temperature of the human body being, in round numbers, 100° F., if a person be submerged in water at the freezing point, *cæteris paribus*, the quicker is the death. This conclusion we have arrived at from the results of experiments on animals, as well as from what we witnessed in the human being a few years ago, when fourteen persons were nearly drowned by the sudden breaking-up of the ice on the water in the Regent's Park. The explanation appears simple enough, when we remember that intense cold paralyzes the muscular energies of the individual, and thereby prevents his continuing the efforts requisite to enable him to get occasional inspirations; consequently the person becomes totally submerged more quickly than he would otherwise be.

Heated water, on the other hand, seems to favor death by hastening the action of the already weakened heart, as well as by accelerating tissue-metamorphosis, and thereby increasing the demand for oxygen.

It is only when water is considerably below or above 100° F. that the effects of temperature become visible; a degree or two one way or the other gives rise to no apparent effect.

Apnœa the result of an absence of oxygen in the respired medium.—The simplest form of death arising from apnœa, or the non-arterialization of the blood, is when there is no obstruction to the entrance of air into the lungs, but merely an absence of oxygen in the inspired gas. This is well illustrated, for example, when an animal is placed in a jar of nitrogen. It dies, and that too in a very few minutes; not from the introduction of a poisonous material into the system, but solely on account of the absence of oxygen in the inspired medium.

Nitrogen is perfectly harmless to animal life. We are constantly breathing it, and suffer no disagreeable effects from it. On the contrary, it is a necessary diluent of the oxygen of the air. The atmosphere normally contains no less than 79 per cent. of it. Nitrogen itself is, however, neither a supporter of combustion nor of life; hence it is that animals cannot live in it. Moreover, they die quicker in perfectly pure nitrogen than when strangled, for the reason previously given, namely, that the inhaled nitrogen displaces a certain amount of the oxygen from the air-vesicles, and thereby reduces the animal to the condition of one whose air-vesicles have been emptied of oxygen by water. The influence of nitrogen extends even somewhat further. For, according to Graham's law of the diffusion, and Henry and Dalton's law of the absorption, of gases, the inspired nitrogen not only displaces the free oxygen present in the pulmonary air-vesicles, but withdraws the absorbed oxygen from the blood itself. This is probably the true explanation of the fact that animals die more rapidly when placed in perfectly pure nitrogen gas than when suffocated in any other way. Hydrogen acts in a nearly similar manner; but its effects on the animal body have not been sufficiently studied to admit of our drawing any general conclusions from them. Some have even hinted that hydrogen gas has special toxic properties; if so, it ought, properly speaking, to come under the next head.

Apnœa from the inhalation of toxic gases and vapors.—There are very few gases that cause death by true apnœa. Most, indeed all, with the exception of nitrogen and hydrogen, and possibly even the latter, as has just been said, kill by means of their toxic properties. Although, therefore, we have been compelled on this occasion to sacrifice scientific accuracy to common custom, and include under the headings of death by apnœa that arising from the introduction into the system of noxious gases and vapors from volatile liquids, we shall merely point out how their action is totally distinct from that of pure apnœa, and then pass on to another department of our subject.

In the case of the inhalation of each of the gases included under this head (see table at p. 93), carbonic acid, carbonic oxide, charcoal vapor, coal-gas, sulphuretted hydrogen, arseniuretted hydrogen, chlorine, sulphuric ether, chloroform vapor, etc., there may be, no doubt, an absence of oxygen in the respired medium; but in no one of these cases can this be regarded as the sole cause of the fatal result. Quite the contrary; it appears rather that the destruction of animal life in the majority, if not in all these cases, depends much more upon the entrance of the toxic agent into the circulation, than upon the mere deprivation of oxygen. Consequently the symptoms manifested in cases of poisoning by these gases differ according to their chemical nature, and the intensity of their poisonous properties. Let us take arseniuretted hydrogen, for instance; if this gas be so given as to exclude the simultaneous introduction of oxygen, the animal dies not only much quicker than it does when its windpipe is tied, but also quicker than when it is suffocated in pure nitrogen gas; the cause of the difference in the rapidity of action being simply due to the toxic effects of the gas upon the nervous system. With chloroform the fact is equally well exemplified. Death from chloroform is commonly placed among the deaths from suffocation. Now, the results of the experiments of the Chloroform Committee of the Royal Medical and Chirurgical Society (1864) have shown that a chloroform death is not one by apnœa at all, but is unmistakably one by pure asthenia. When the undiluted vapor of chloroform is introduced into the lungs, animal life is rapidly destroyed, much more rapidly, indeed, than under the very quickest form of death by apnœa. Thus, while a drowned dog makes attempts at respiration during at least two minutes, and its heart's action continues to be perceptible for seven minutes, a dog poisoned with undiluted chloroform vapor inevitably dies in fifteen seconds; both respiration and cardiac pulsation being totally annihilated in that brief space of time. These are fortunately not the usual effects of chloroform; for since it is generally given in a diluted state, the oxygen of the atmospheric air with which it is accompanied suffices to arterialize the blood sufficiently for the maintenance of organic life. But even death arising from diluted chloroform vapor is in no case due to apnœa, but to the poisonous nature of the substance itself. This is proved by the cessation of the heart's action occurring almost as soon as efforts at respiration cease, as well as by the blood on the right side of the heart being darker than on the left, neither of which is ever the case in apnœa; the heart in apnœa always continuing to beat two or three minutes after the respiration has stopped, and the color of the blood on both sides being invariably identical.

Even carbonic acid circulating in the capillaries acts as a direct poison on the tissues. This we have seen well illustrated while studying the duration of the cardiac pulsations after different modes of death. Thus, the heart of a cat that has been suddenly deprived of life by section of the spinal cord at the vital point, will continue to pulsate, under favorable circumstances, for forty minutes after the animal's death; whereas the heart of a cat allowed to die slowly by strangulation, under the same circumstances, generally stops in less than twenty minutes after the death of the animal.

Enough, we think, has been said to show that these gases and vapors are in reality active poisons; and perhaps also sufficient to convince our readers that, notwithstanding the extreme interest of the subject, it would be injudicious for us to give to it more prominence in an essay on apnœa.

THEORY OF THE CAUSE OF DEATH IN APNŒA.

Various authors in explaining, or attempting to explain, the reason of the cessation of the vital functions in cases of death by apnœa, have given very different views of the subject. One ascribes the death to a mechanical stagnation of the blood in the lungs (Haller's original doctrine). Another thinks it due to the non-stimulating venous blood failing to excite the heart's action (Goodwyn). A third, to the poisonous effects of venous blood upon the tissues (Bichat). A fourth, to the gradual failing of the blood to penetrate the pulmonary tissue (Alison). While, lastly, the doctrine which has now received almost universal assent is that first propounded by Kay, namely, that the cause of death in apnœa is due to the circumstance of the capillaries of the lungs, which usually convey arterial, being incapable of conveying venous blood; and consequently that the blood, as Haller said, stagnates in the lungs. Moreover, that the functions of the muscular organs, the heart included, gradually cease on account of this arrest of the pulmonary circulation, and not, as Bichat imagined, because of venous blood possessing any noxious quality.

It is thus seen that, in Kay's doctrine, although it is doubtless admitted that in death by apnœa the heart's action is weakened in consequence of the imperfect stimulus afforded to it by the venous blood penetrating its substance, the main cause of the failure of the circulation is supposed to be the difficulty which the non-arterialized blood finds in passing through the capillaries of the lungs.[1] This theory was thought consistent with all the phenomena observed in cases of death from apnœa. It will be found, however, from what has preceded, that in the explanation of apnœa, as now understood, this theory is open to objections. Indeed, the same observation is applicable to all the theories that have as yet been advanced; for the particular reason, that they one and all, with the exception of Goodwyn's, have for their foundation that part of the original doctrine of Haller which attributes the failure of the heart's power and loss of nerve-function to the arrest of the pulmonary capillary circulation.

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[1] Vide Watson's Lectures on the Practice of Medicine, 3d ed., vol. i., p. 69.

The result's of Goodwyn's experiments, had they been properly considered, might have led to a different conclusion from the above; for in them it is clearly shown that, for a time at least, the non-arterialized blood passes through the lungs, and enters the left auricle and ventricle of the heart. Moreover, in apnœa it is the right side of the organ that first ceases to pulsate. Bichat appears to have had a clearer idea of the sequence of death in apnœa than any previous or subsequent writer, and may be said to have only failed in arriving at the truth from having held to the idea that venous blood poisons the tissues with which it is brought in contact.

In attempting to explain the cause of death by apnœa, it is necessary to go a step or two farther than has hitherto been done; and, instead of merely limiting the question to an explanation of the most prominent of the effects of this mode of death, to attempt to follow up the subject until we arrive at the proemial cause of the arrest of the various functions. In order to do this it is necessary to begin ab initio.

As is well known, the continual afflux of arterialized blood to the various animal tissues is a condition not only important but imperative to the continuance of life. All the molecular transformations of organized matter, of which "life" is but the manifestation, are so utterly dependent on the continued supply of scarlet blood, than no sooner is it cut off than they instantly cease. Without oxygen there can be no life. Not a single new cell can be formed, not a single old one can be destroyed, without the influence of this all-important agent. From the first moment the animal germ springs into existence, during its development into tissues, and throughout its whole life as an organized body, up to the time of its death, arterialized blood is being uninterruptedly employed; and in exact proportion to its supply, cæteris paribus, are the many and intricate organic functions accelerated or retarded. Nervous action, muscular contraction, secretion, and excretion, are all equally under its sway; so that it is impossible to feel in the least degree astonished that in apnœa, which essentially consists in the arrest of the oxygenization of the blood, all the functions of life should be rapidly brought to a standstill.

Apnœa may with perfect justice be defined as death from arrested interstitial nutrition.

Were it considered necessary to prove the basis on which this doctrine rests, there would be no difficulty in so doing; for all that is required is simply to draw a parallel between the effects of a deficient supply and an impaired quality of nutritive material on the various functions of the body, when it will be immediately seen that their effects are in reality identical. For example, we have a striking illustration of the effects produced on the body by a sudden deficiency in the supply of blood presented to us in cases of death by hemorrhage. In these cases there is of course an actual absence of nutritive materials; and, as will presently appear, that absence gives rise to precisely the same chain of symptoms as is met with in pure apnœa; which, on the other hand, is an apt illustration of the effects of an impaired quality of the material.

Thus, in death by hemorrhage, there are the confusion of ideas, the unconsciousness, the convulsions, the stupor, the paralysis of the muscles, the stoppage of respiration, and, lastly, the cessation of the heart's action; all following upon each other in precisely the same order of sequence, and with the same ultimate result, as in those cases where there is no absence of the material themselves, but only of that substance which fits them for the performance of their peculiar office—oxygen.

The same thing even occurs, when not only the materials but also the oxygen itself is present, if the two are prevented from combining, and thereby becoming fitted for the purposes of nutrition. This occurs, for example, when there is present in the circulation a foreign material which possesses the property of preventing the constituents of the blood from entering into combination with oxygen. In such a case precisely the same symptoms may be induced as we have seen follow either the entire absence of both nutritive materials and of oxygen, as in hemorrhage; or only an absence of oxygen, as in apnœa. Alcohol might be cited as an example of a substance possessing the power above alluded to; and the symptoms it gives rise to, when taken in a poisonous dose, closely resemble in many respects the effects of slowly-induced apnœa. The peculiar effect which alcohol exerts in preventing the oxidation of the constituents of the blood has been illustrated by us in the following manner:—

A certain amount of cow's blood was confined with an equal quantity of pure atmospheric air, and kept at a moderate temperature during twenty-four hours. At the expiration of that period the air was found to have undergone a change: it had lost oxygen and gained carbonic acid.

For while the pure atmospheric air brought in contact with the blood consisted of

Oxygen . . .	20.960	total 20.962
Carbonic acid .	0.002	
Nitrogen . . .	79.038	
	100.000	

that removed from the retort after its twenty-four hours' contact with the blood consisted of

Oxygen . . .	10.58	total 14.9
Carbonic acid .	3.33	
Nitrogen . . .	86.09	
	100.00	

thereby showing that oxygen had been absorbed, and carbonic acid exhaled. To a precisely similar quantity of blood from the same animal was added 5 per cent. of alcohol. The blood was then placed in contact with an equal amount of pure atmospheric air, and kept twenty-four hours at the same temperature and under precisely the same circumstances as the others; notwithstanding which the air on analysis was not found to have become nearly so much changed as in the second case when it was in contact with pure blood. On the contrary, the air was found on analysis to consist of

Oxygen . . .	16.59	total 18.97
Carbonic acid .	2.38	
Nitrogen . . .	81.03	
	100.00	

proving that alcohol possesses to some extent the power of arresting the arterialization of the blood, and thereby its becoming fitted for the purposes of nutrition.[1]

The effects of alcohol and many other substances on the nervous system are, in a great measure, due to their action on the blood; and, if the above explanation be the correct one, there can be no difficulty in understanding why, in certain cases of poisoning, the symptoms so frequently resemble in some respects those met with in pure apnœa.

As a further illustration of the intimate connection between functional activity and oxidation, we might call attention to what is observed to occur during muscular contraction.

It is a well-known fact that the exposed muscles of the frog absorb oxygen and exhale carbonic acid in definite proportion, so long as muscular irritability continues; and that as soon as the irritability of the muscles ceases, an important difference occurs in the amount of the gases interchanged. Moreover, we have found that anything that interrupts the interchange of the gases tends to arrest the muscular action. This is best seen in connection with the rhythmical action of the involuntary muscles of the heart when it has been separated as far as possible from all nerve-influence. As is well known, the extirpated heart of a healthy frog will continue to pulsate regularly for an hour after its separation from the nerve-centres; we have, however, observed that if the heart be placed in contact with any of those substances that possess the power of preventing the arterialization of the blood, its action is speedily arrested. In illustration of this we may cite the following experiment which we performed several years ago (Lancet, 14th June, 1856).

When the hearts of two frogs are removed from the body, and one placed in pure distilled water, while the other is put into a solution of the acetate of strychnia (strychnia has the power alluded to, of preventing the absorption of oxygen and exhalation of carbonic acid by the blood), the former will pulsate regularly for more than an hour, the latter will cease to beat in from *one* to *five minutes*, according to the strength of the solution of the poison. And what is still more remarkable, the contractile power of the heart is gone forever. Mechanical, chemical, or galvanic stimuli alike fail to reawaken it.

(Since the foregoing was written, we have had occasion, in the capacity of member of the Royal Medical and Chirurgical Society's Chloroform Committee, to study the effects of the direct action of the vapor of chloroform and ether upon the heart. For this purpose the following experiment was performed: Three small glass jars were placed in a row, and each covered with tinfoil from the centre of which descended a small hook, to which was attached by the aorta the heart of a healthy frog. All three were retained under precisely the same circumstances, with the exception that in the bottom of one jar were a few drops of chloroform, in another a similar quantity of ether, and in the third the same amount of distilled water. The result was, that while the heart that was suspended in aqueous vapor pulsated regularly for an hour or so, that in ether-vapor stopped in less than fifteen minutes, while the one in the atmosphere of chloroform ceased to pulsate within ten minutes. Facts which add still further strength to the foregoing opinion.)

No one, we suppose, at present doubts the fact that the ultimate cause of death in apnœa, no matter in what manner it may be induced, is the absence of oxygen. We may add, that in our opinion this absence of oxygen acts indirectly, and that the extinction of animal life is in consequence of the constituents of the blood not having undergone the oxidation-process, which is essential to the proper performance of their functions when brought in contact with the various tissues and organs of the frame. The confusion of ideas, the unconsciousness, the convulsions, the stupor, the paralysis of the muscles, the stoppage of respiration, the arrest of the heart's action, appear to us to be one and all due to the same cause, *arrested interstitial nutrition*. It is thus seen, then, that what others have hitherto regarded as the primary cause of death in apnœa, namely, the stoppage of the circulation in the lungs, the failure of the heart's action, etc., we look upon as merely the secondary effects of the gradual extinction of life. No one would, of course, venture to assert that the above is of necessity the true explanation of death by apnœa; for all are well aware that, as science advances, new facts may be discovered which may either demand its modification or abandonment; but one thing we may venture to assert, namely, that this "arrested interstitial nutrition" theory is by far the least open to objection of any that has hitherto been propounded, and that it has the advantage not only of giving a rational explanation of the symptoms, and their order of sequence, but is also in perfect conformity with the appearances observed after death.

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[1] See the author, On the Influence of Physical and Chemical Agents upon Blood, with special reference to the Mutual Action of the Blood and the Respiratory Gases, Phil. Trans., 1865, p. 717.

SECONDARY APNŒA.

We have now to call attention to the fact which has been so frequently observed, more particularly in cases of drowning, that an individual may apparently recover from the primary effects of apnœa, and after the lapse of some minutes, hours, or days, suddenly expire without any apparent cause. This secondary death occurs not only after drowning, but after each and all of the causes of apnœa given in our table. Indeed, it is not much less common after hanging than after drowning; and it has been equally observed after the administration of poisons, more especially of the volatile group denominated anæsthetics.

Lest some may imagine that the secondary form of death now under consideration is nothing more than death following upon imperfect resuscitation, we may at once inform them that it is entirely different. Take, for example, a case of drowning; and we may quote the following, which we heard of in consequence of the gentleman in whose practice it unfortunately occurred being unjustly accused of having treated the case improperly. The patient, a healthy young man, while bathing, accidentally got out of his depth, and before being rescued became much exhausted. On his removal from the water, he was quite unconscious, although the respiratory process still continued. The usual restoratives were applied, and the patient was soon able to speak. He was taken home, and, at the suggestion of the medical attendant, who considered him out of all danger, had some opening-medicine given to him and was put to bed. In the middle of the night, about ten hours after his immersion, he was suddenly heard, by a person who occupied the same apartment, to make a noise, as if in a convulsion. When a light was obtained, it was found that he had become quite livid in the face; and before medical aid could be procured, he expired. At the post-mortem examination nothing was detected to account for the sudden death.

This we regard as a death from secondary apnœa.

Sir B. Brodie relates the case of a lad who was found hanging by the neck insensible, who died twenty-four hours after he was cut down; and at the post-mortem examination nothing abnormal was detected in the body, except congestion of the cerebral vessels.

Linhart, again, relates a most interesting case of a perfectly healthy peasant who died eighteen and a half hours after having been rendered only partially insensible by an ounce and a half of chloroform given in the usual way over a period of thirty minutes. The patient continued perfectly well until the next morning at six o'clock, when he suddenly died. On examining the body, twenty-four hours after death, all the organs were found healthy.

These cases, which have generally been classed under the head of death either arising from collapse or from spasm of the glottis, are certainly peculiar; but nevertheless we consider them as merely the secondary results of the arrested interstitial nutrition that took place during the period that the breathing was partially arrested.

If we may be allowed to use a homely expression, in order to illustrate how the secondary apnœa may arise from a preceding mal-nutrition, we should say that it does so in the same way as a single layer of bad bricks put into a house while building may cause at a subsequent period its premature decay; the layer of bad tissue laid down during the temporary cessation of respiration induces the subsequent premature decay of animal life.

This theory will be still better understood if we illustrate it by what is observed to occur to horses after temporary starvation

Many years ago the French government appointed a commission to inquire into the effects of starvation on cavalry horses; and the results obtained were not only interesting, but most important. Among others, for example, it was found—

1st. That after ten days' total deprivation of food, a horse is still able to gallop, although not very long; and after being again well fed, makes a tolerably rapid recovery.

2d. That a horse may live for twenty days without nourishment of any kind, and still make a temporary recovery.

3. That an animal starved for a certain time, although he makes a temporary recovery never regains his pristine strength, no matter how well fed he may subsequently be.

Thus it was found, that though the horses that had been kept fasting during a period of ten days, and then well fed, apparently recovered rapidly from the effect of the starvation, yet they never were so strong as other horses, and that they succumbed to disease much more readily than others. This failure in the vital stamina, if it may be so termed, we believe was owing to the mal-nutrition that occurred during the previous term of starvation. The subsequent death of the horse might therefore be said to be the secondary result of starvation. The peculiar condition of the red blood-corpuscles which was mentioned as occurring in case of drowning, may in some degree aid in the understanding of what is here termed mal-nutrition, as applied to the secondary apnœa of drowning. It will be remembered that, while abundance of serrated blood-corpuscles was found in the blood of the right side of the heart, there was not only a total absence of them in the watery blood of the left, but that a great number of the normal blood-cells had disappeared; the field being occupied by small granular bodies, looking something like nuclei, that might have escaped from the swollen and burst corpuscles. This observation was of course made upon a fatal, and consequently exaggerated, case; but it is very easy to imagine a less formidable one, in which, during the period of recovery from the effects of drowning, a layer of bad tissue might be deposited from the partially disorganized blood corpuscles, which of necessity would diffuse themselves throughout the circulation along with those that had escaped the pernicious action of the water. We are here speaking of the visible effects of drowning upon the circulation; but how many and intricate are the changes which may have taken place in the blood, during the period of apnœa, that are entirely beyond the cognizance of our senses!

In order properly to comprehend the meaning and pathology of secondary apnœa it is necessary to have a clear idea of the process of nutrition.

It is a common belief that, as we eat and sleep at stated periods, nutrition is not a constant but an intermittent function; an opinion from which we entirely dissent, as not being in conformity with the present state of physiological science. To our mind nutrition appears to be a constant process; fluctuating, it may be, but nevertheless continual. The secretion of milk, urine, bile, and semen goes on during every hour of the day and every minute of the night. It is only the expulsion of the accumulated products that is periodic. So again with food. Just as the camel can pass several days without drinking, if he has previously supplied his reservoir with water, so can man go several hours without eating, if he has previously laid into his stomach a stock of food. The animal, like every other machine, to do constant work must have a constant supply of material. Life, indeed, might not inappropriately be compared to a web of cloth made of the purest American cotton, and each stoppage in nutrition to a flaw. Thus each disease, each temporary illness, although not producing an actual gap, would weaken the web by introducing into it an inferior quality of cotton. It might only be a single thread, or it might be many threads; but still the web would be weakened by their presence. Do we not every day see around us evidence of the flaws in the human webs. Look, for example, at the teeth. Are the furrows we occasionally see across them not the tell-tales of the severe illness of youth? Are they other than the marks of arrested nutrition? So again with the nails; do they not, after a smart attack of scarlet-fever, indicate by their grooves the severity of the illness? Can the falling out of the hair after typhus be said to be due to anything else than temporarily arrested nutrition? Even the mind itself does not escape the general ill. Bad tissue deposited produces bad memory. Old people remember distinctly all that occurred to them in their youth, when good tissue was being laid down; but forget the occurrences of the previous day, when in old age the material is of an impaired quality. So also it is found, and for a similar reason probably, that it occasionally happens that, after a severe illness, little is remembered of what occurred during it. Interstitial nutrition is constantly going on, and it cannot be for an instant interrupted without threatening to bring the machine to a stand-still. Moreover, we might go a step farther, and say that the more quickly it does its work the sooner will its labors cease. Waste and repair cannot go on indefinitely in the animal body any more than in the locomotive. Supply the engine with coals and water as carefully as you will, it will still wear out. That is, however, not the point with which we have at present to deal. It is the temporary arrest of the supply of material we are now considering; and as we have already said, during the period of apnœa it is that supply that is interfered with, and makes the flaw which, although not sufficiently great to produce at once a rent in the web (immediate death), sooner or later causes it to give way (secondary apnœa).

Treatment of Apnœa.

In considering the treatment of cases of impending death by apnœa, it will be advisable, in order to save time and space, first to lay down the general principles on which it is founded, and afterwards to proceed to show in what manner these require to be modified in their application to special cases.

Having ascertained from the history and symptoms that the case is one of apnœa, and not of narcotic poisoning or apoplexy, which, as has been previously shown, under certain circumstances may be confounded with it, the first thing to attend to is the removal of all visible impediments to the natural performance of the respiratory process, and then as rapidly as possible to place the patient under the most favorable circumstances for the reception of a free supply of air. Having done so, time may be taken to inquire more minutely into the state of the patient, and thereby obtain some notion of the probable chances of recovery.

If the eyes are open, the pupils dilated, the conjunctiva insensible, the countenance placid, the skin cold, frothy mucus round the nostrils and mouth, no attempt at respiration, and the heart's action inaudible, the case is hopeless. N. B. As the pulse ceases to be perceptible at the wrist some time before the action of the heart entirely stops, the ear must in all cases be applied to the chest before definitely concluding that the case is hopeless.

If, on the other hand, there is the slightest evidence of respiratory effort, of heart's action, of twitching of any of the muscles, and especially if the apnœa is known to have been of short duration, there is every hope of recovery; and in direct proportion as either or all of the above signs are marked, are the chances of recovery increased. As the primary object in all cases of apnœa is to arterialize the blood as rapidly as possible, various methods for the accomplishment of this object have at different times been proposed. Numerous forms of apparatus have also been invented, in order the more readily to perform artificial respiration, several of which we have tried (Erichsen's, Sibson's, Marcet's, etc.); but we cannot venture to recommend their employment. First, they are not always at hand; secondly, there is no time to send for them, even although they could be procurable in the short space of two minutes; thirdly, they are troublesome in the application; and fourthly, after a pretty large experience with them on animals, we may venture to affirm that they are at last not more effectual than the apparatus-less modes we are now about to describe.

1st. Artificial respiration by simultaneous pressure on the abdomen and thorax.

2d. The Marshall-Hall method.

3d. The Silvester method.

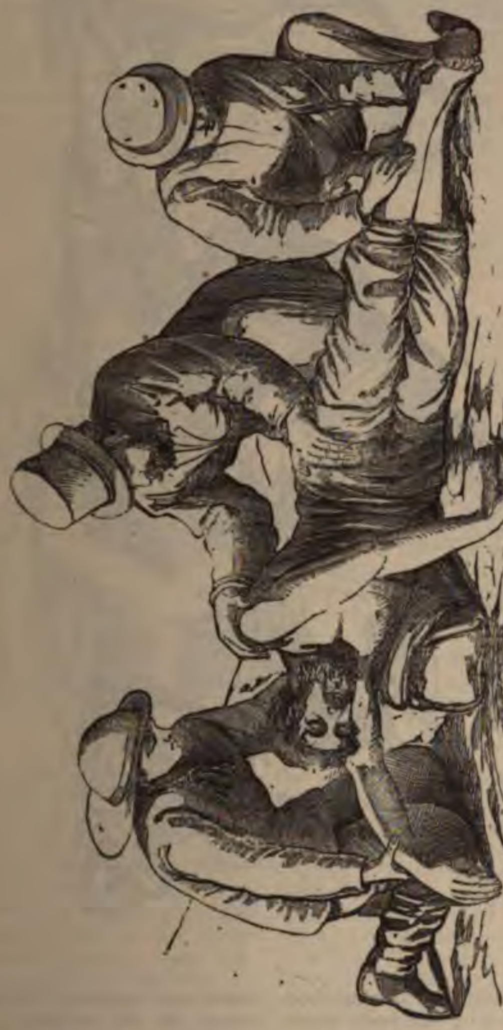
Artificial respiration by simple pressure on the abdomen and thorax.—As is familiar to every one, a certain volume of air can be expelled from the thorax by forcible compression of its walls; on the removal of the pressure, the walls of the chest return to their former position in consequence of their own elasticity, and air rushes into the lungs in order to fill up the vacuum thereby produced. Consequently, by a regular repetition and relaxation of pressure, a species of artificial respiration may be induced, the volume of air inhaled and expelled varying with the amount of the pressure.

When manual pressure equal to about 30 lbs., which is not greater than may be with perfect safety applied to an adult human subject, is made over the lower part of the sternum and upper and middle portion of the abdomen, from 8 to 20 cubic inches of air are expelled and readmitted on the relaxation of the pressure; and by repeating this twenty or thirty times in a minute, sufficient oxygen may be obtained to support life.

In making the abdominal pressure, care is to be taken to observe if any food is forced out of the stomach, which may happen if that viscus is full; and if so, it is necessary that care be taken to prevent it getting into the windpipe. This may be readily done by placing the patient for a few seconds on his face and forcibly expelling the food.

The pressure ought not to be made on the upper part of the sternum, for the resilience of the thoracic walls there is not great enough to allow of the expulsion of sufficient air for the purpose of respiration; nor is the pressure on the abdomen to be omitted, else the diaphragm will descend, and counteract the benefit derived from that made on the lower part of the chest.

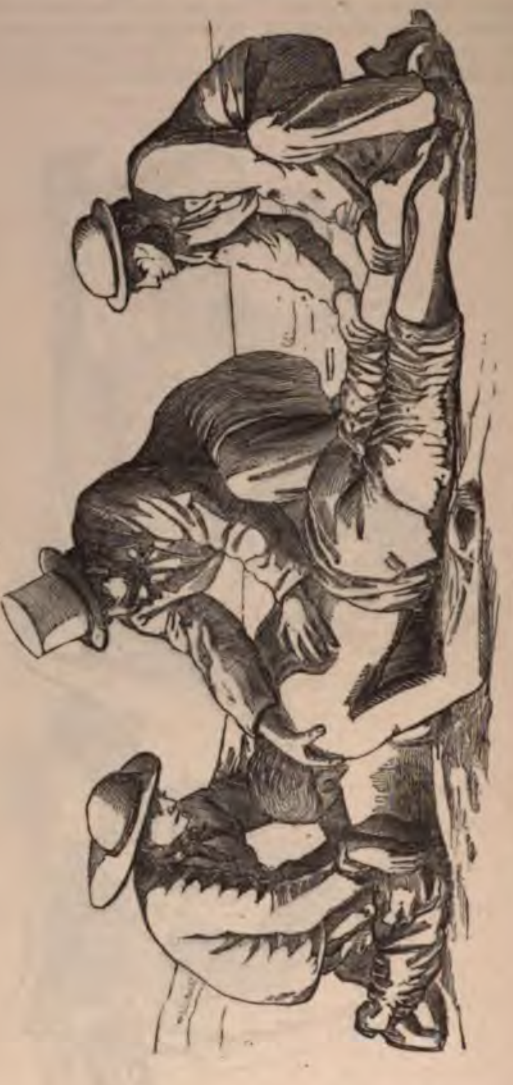
Fig. 565.



Inspiration.

Dr. Marshall Hall's method of performing artificial respiration.—The method of imitating natural respiration recommended by the late Marshall Hall is too well known for us to take up time in describing it; we may simply mention that it consists essentially in "turning the body gently on the side and a little beyond, and then briskly on the face, alternately;" and in making pressure along the back of the chest each time the body is brought into the prone position. Within the last few years this method has been largely practised throughout the country, and most favorable reports of its efficacy have from time to time been published by different gentlemen in the weekly periodicals. Notwithstanding this, however, we must admit that we are extremely sceptical regarding its advantages; and we are doubtful if the recoveries which are reported as having taken place under its use have been attributed to the proper cause. But lest it should be thought that we have an improper bias for any particular method, we shall, in preference to giving our own views regarding the comparative value of the Silvester and Marshall-Hall methods, give the published opinions of the Royal Medical and Chirurgical Society's Committee, with which our own entirely accord. The committee applied the "ready method" and the "physiological method," as they were termed by their respective proposers, to a number of recently dead human subjects, in exact accordance with the published instructions by the authors; and the conclusions they arrived at are the following:[1]—

Fig. 566.



Expiration.

"As regards that part of the method which consists in turning the body alternately 'very gently on the side and a little beyond, and then briskly on the face,' it was found that the volume of air exchanged was variable in the same subject, but always inconsiderable. It usually happened that a quantity of air, varying from 1 to 8 cubic inches, never more, generally much less than 8, was inspired when the body was turned from the supine posture to one side. When the body was placed on the abdomen with the head resting on the forearm, a somewhat larger quantity was expelled, never exceeding 10 cubic inches. On restoring the body to the lateral posture, the amount of air inspired was usually less than that which had been expelled by pronation. But the quantity expelled and inspired in each movement was scarcely ever precisely equal.

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[1] Med.-Chir. Trans., vol. xlv., p. 488.

"The volume of air expelled when the body was placed on the face was much increased if pressure was at the same time made on the spine, the amount of this increase varying according to the degree of the pressure; and in those experiments in which such pressure was made, it was found that the quantity of air which was inspired on rotation of the body to the side was much less than that which had been expelled by pressure.

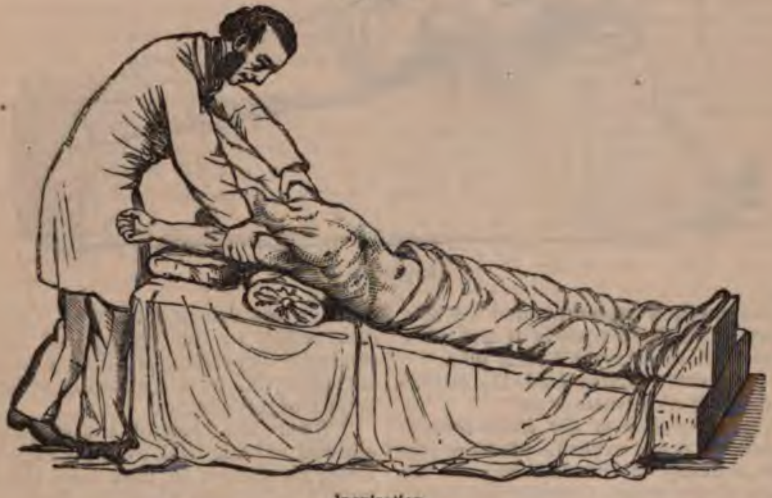
"As regards the whole amount of exchange of air produced by the method of Dr. Marshall Hall, to 'imitate respiration' it varied much according as the subject was favorable or the contrary, sometimes not exceeding a few cubic inches, but never exceeding 15 cubic inches."

Figs. 565, 566 illustrate, more fully than any number of words can, the positions of the body during the employment of Dr. Marshall Hall's method of inducing respiration.

Physiological method recommended by Dr. Henry R. Silvester.—Dr. Silvester's method consists in the imitation of the action during deep inspiration of the pectoral and other muscles passing from the shoulders to the parietes of the chest. The inspiratory effort is imitated by slowly extending the arms upwards by the sides of the head until the elbows nearly touch each other. The expiratory effort is performed by restoring the arms to the sides of the chest, and slightly pressing them against it.

In performing Dr. Silvester's method on the same subjects that were either previously or subsequently employed in practising the "ready method," the committee "found that, on extending the arms upwards, a volume of air was inspired into the chest which varied, in different subjects, from 9 to 44 cubic inches; and it was observed that the results obtained in successive experiments on the same body were remarkably uniform, in which respect, as well as in their quantity or amount, they contrasted with those obtained by the method of Dr. Marshall Hall. On restoring the arms to the side, as directed by Dr. Silvester, the quantity of air expelled was generally nearly equal to that previously inspired; occasionally less.

Fig. 567.

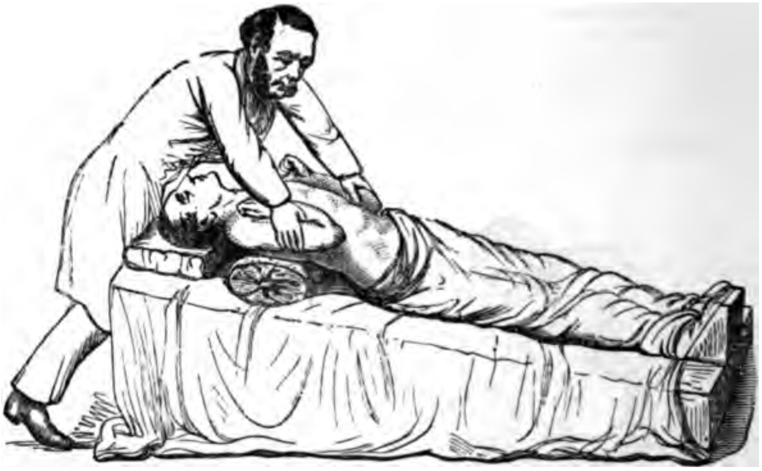


Inspiration.

"Dr. Silvester recommends that on bringing down the patient's arms they should be gently and firmly pressed against the sides of the chest, so as to diminish the cavity of the thorax. It was found that this pressure could be exercised with greater facility, and equal effect, by placing the hands on the lower third of the sternum, as already above described. By alternating the movement of the arms with pressure of this kind, a regular exchange of air was produced, the quantity of which, in several instances, exceeded 30 cubic inches, and in one instance amounted to 50 cubic inches. In those cases in which a less respiratory effect was produced, the deficiency was always distinctly attributable to unfavorable conditions, particularly the existence of obstructions in the respiratory passages.

"Without expressing an opinion as to the efficacy of the method of Dr. Silvester as a means of restoring suspended animation in cases of drowning, its claims to be considered as an effectual means of producing an exchange of air similar to that effected by the respiratory movements appear to us to be satisfactorily established. As has already been pointed out by Dr. Silvester, the condition of the thorax after the cessation of breathing being that of expiration, it is desirable that the first step in the restoration of breathing should be a movement of expansion; in this respect the method he has proposed enjoys a marked superiority over that of Dr. Marshall Hall, which has for its object to force air from a chest which has already discharged its natural quantity. It also appears to be an important advantage in this method, that, in each movement of expansion, both sides of the chest are left free from compression, and therefore free to move, while the postural method of Dr. Marshall Hall leaves only one side free to expand. As regards facility and readiness of application, there is also no doubt that the method recommended by Dr. Silvester is at least equally if not more effective than the Marshall-Hall plan."

Fig. 568



Expiration.

The committee further made the following important observations on

Artificial inflation of the lungs through the mouth.—"A few experiments were performed relating to the efficiency of the inflation of the lungs through the mouth of the subject, which led to the conclusion that with proper precautions such inflation is perfectly practicable. The following were among the results noticed:—

"1. As regards the position of the tongue and its influence in impeding the entrance of air, it was found that in the dead body this organ is apt to offer great obstruction to inspiration by falling back into the pharynx and closing the laryngeal aperture. No air could be forced through the mouth in a body lying on the back so long as the tongue remained undisturbed; but when it was drawn forward and held out of the mouth by a ligature, or by the pressure of the teeth upon it, air could be injected by the œsophagus and larynx, so as to distend both the abdominal and thoracic cavities. On leaving the tongue loose in the mouth, and allowing it to fall back by its own weight, air could also be introduced; but much less freely than when it was drawn forwards. Complete obstruction to the passage of air was produced by pressing the tongue back into the pharynx, no air entering either the larynx or œsophagus.

"When the head of the subject was allowed to hang back over the edge of the table, air seemed to pass into the chest more readily than when the back of the head rested upon the table.

"2. It was found that the whole quantity of air introduced by inflation could be compelled to enter the respiratory cavity by pressing back the larynx against the spinal column. By this expedient the passage of air down the œsophagus was at once intercepted; while its transit down the trachea continued to take place as freely as before, so that it affords a ready means of preventing the passage of air into the stomach during artificial respiration.

"3. During inflation of the lungs, a sound closely resembling that of the ordinary vesicular murmur is plainly heard, proving that air enters not merely the larger air-passages, but the vesicular structure of the lungs. Marked expiratory murmur was also heard during the recoil of the lungs and thoracic parietes after inflation. In cases where the bronchial tubes were obstructed by secretion, the various kinds of crepitation could be distinguished.

"*Rigor mortis.*—The effects of rigor mortis were judged of by observations on one subject especially. It was observed that, after prolonged experiments, the rigidity, which at first existed in a marked degree, was completely overcome and abolished by the repeated movements of the arms and thoracic parietes. As this change took place, the quantity of air inspired and expelled increased, so that at the end of the period of observation the results were nearly twice as large as they were at the beginning."

The committee summed up its labors by making the following suggestions regarding the treatment of apnœa generally; but in giving to them all due consideration, it must be borne in mind that the investigations of the committee related only to two forms of apnœa—that produced by a simple mechanical obstruction to the entrance of air into the lungs, and that produced by drowning. Its conclusions are as follows:—

"That all obstructions to the passage of air to and from the lungs be at once, so far as practicable, removed; that the mouth and nostrils, for example, be cleansed from all foreign matter or adhering mucus.

"That in the absence of natural respiration, artificial respiration, by Dr. Silvester's plan, be forthwith employed in the following manner: the body being laid on its back (either on a flat surface, or better, on a plane inclined a little from the feet upwards), a firm cushion, or some similar support, should be placed under the shoulders, the head being kept on a line with the trunk. The tongue should be drawn forward, so as to project a little from the side of the mouth; then the arms should be drawn upwards until they nearly meet above the head, the operator grasping them just above the elbows, and then at once lowered, and replaced at the side. This should be immediately followed by moderate pressure with both hands upon the lower part of the sternum. This process is to be repeated about twelve or fourteen times in the minute.

"That if no natural respiratory efforts supervene, a dash of hot water (120° Fahrenheit) or cold water be employed, for the purpose of exciting respiratory efforts.

"That the temperature of the body be maintained by friction, warm blankets, the warm bath, etc.

"In the case of drowning, in addition to the foregoing suggestions, the following plan may be, in the first instance, practised: place the body with the face downwards, and hanging a little over the edge of a table, shutter, or board, raised to an angle of about 30°, so that the head may be lower than the feet. Open the mouth and draw the tongue forward; keep the body in this position for a few seconds, or a little longer if fluid continues to escape. The escape of fluid may be assisted by pressing once or twice upon the back."

There are two other methods still to be alluded to: one by Professor Pacini,[1] the other by Dr. Bain. In the former the asphyxiated patient is placed horizontally on a bed or table; the operator, standing with the head against his own belly, takes hold of the patient's shoulders, by applying the thumbs in front of the heads of the humeri, and the four fingers behind and close to the armpits. He then pulls the shoulders towards him, and lifts them in a perpendicular direction, by which means the thoracic cavity becomes enlarged, both in its transverse and antero-posterior diameter, thereby admitting the ingress of air, which is expelled on the shoulders being replaced in the former position. If the patient is on the ground, the operation is performed by the practitioner while kneeling.

Dr. Bain thus describes his method: "The patient being laid on his back on a table, if convenient, the mouth and nostrils are to be wiped dry—the clothes from the upper part of the body, at least, having been removed. The operator stands at the head of the patient, placing the fingers of each hand in the axillæ, in their front aspect, with the thumbs on the clavicles, and pulls the shoulders horizontally towards him with a certain degree of power. Upon relaxing his pull the shoulders and chest return to their original state."

These two methods are therefore but a mere modification of Silvester's plan, the modification consisting in the upper, instead of the lower, part of the arms of the patient being the point of traction.

A committee appointed by the Roy. Med. and Chir. Soc. examined these respective methods, and found that although more air can be made to enter the chest when the traction is made upon the shoulders instead of the forearm or arms, the difference is so slight that in the great majority of cases it is of comparatively little moment which method of manipulation is practised, provided the common principle on which they are founded is fairly carried out.[2]

Having said thus much on the general bearings of treatment in cases of apnœa, we have now to consider some of the special bearings as applicable to particular cases. It will be remembered that we classified the different forms of apnœa under the four heads of— that arising from a mechanical impediment to the entrance of air into the lungs, that produced by drowning, that caused by an absence of oxygen in the inspired medium, and that due to the inhalation of a toxic gas or vapor. As regards the first of these causes; it ought never to be forgotten that apnœa may arise from mechanical causes, and yet, *even while the cause exists* it may fail to be detected, and the patient be allowed to die in consequence. This happened not long ago. A cabman, sitting on the step of his cab, eating his dinner, was suddenly hailed by a fare. He jumped up, pushed the remainder of his meal into his pocket, sprang on to the box and seized the reins, when immediately afterwards he was observed to become livid in the face, and with scarcely a struggle fell back insensible on his seat. A hospital being close at hand, he was instantly conveyed thither; but although only a few minutes had elapsed, he was found to be dead almost as soon as he was brought into the waiting-room. The case was thought to be one of apoplexy, and was treated as such; that is to say, nothing was done; no attempt at resuscitation was made; and it was not until the autopsy revealed the true cause of death that the idea occurred that the man's life might have been saved. A piece of unchewed meat was found sticking in the throat and plugging up the opening into the larynx. There can be but little doubt that if this had been discovered and removed when the man was first brought into the hospital, its removal, in all probability, would have been followed by recovery, either with or without artificial means. Cases of this kind are not so very uncommon. Several have been reported in the journals.[1] It ought also to be borne in mind that suicide and even murder have been committed by thrusting substances into the fauces. A pocket-handkerchief is said to have been the instrument in one case; a ball of cotton in another.

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[1] Di un nuovo Metodo di praticar la Respirazione artificiale.

[2] Trans. Roy. Med.-Chir. Soc., vol. liii.

It also occasionally happens that children are suffocated in attempting to swallow their playthings. In 1851, we saw Trousseau rescue a child from impending death by the timely performance of tracheotomy, and the extraction of a cherry-stone which had become lodged in the trachea. It is not necessary even that the plaything enters the trachea; if it be of considerable size, as in the case of a whistle, it may stick in the œsophagus, and by its pressure on the trachea obstruct the entrance of air into the lungs.

Feeble children, and still more frequently intoxicated adults have been suffocated from food ejected out of the stomach getting into or blocking up the orifice of the trachea. A drunken man perished once after vomiting, from a piece of potato-peel covering the glottic orifice. The cause of death remained unknown until it was revealed at the post-mortem examination.[1]

On more than one occasion it has happened that not only during life, as in the above cases, but even after the autopsy, and until a second and more searching examination of the body has been made, the true cause of the apnœa has failed to be detected.

It may be useful, perhaps, to know that in nearly all cases of plugging of the respiratory passages, a clue may be obtained to the mischief by the lungs refusing to collapse on the chest being opened. This of course arises from the air contained in them being unable to find an exit in the usual way.

As regards the accidental suffocation of children by bedclothes or wearing-apparel too closely covering their faces, we would remark that this accident, which has ocsionally arisen from excessive care as well as excessive carelessness, the practitioner is in some cases able to remedy. Cases of this kind, when seen sufficiently early, are admirably adapted for treatment by artificial respiration. There being no violence or injury of any kind either to the air-passages or to the lungs, death arises from non-arterialization of the blood in one of its least complicated forms. So that, if the heart's action is still perceptible, no matter how feeble it may be, the chances of recovery by artificial inflation are exceedingly great. We have just said that this accident may happen from excessive care; a good example of this occurred not long ago. A young mother, while carrying her first-born to church to be baptized, in order the more effectually to protect it from the cold, turned up the end of her shawl, and drew it over the infant's head. On arriving in church and uncovering her charge, she for the first time discovered that her excessive care had proved fatal to her child.

In a case of this kind inflation should be had recourse to, even after the heart's action has stopped; and it should be continued for at least a quarter of an hour or twenty minutes. We have seen new-born children recover after that period from suffocation.

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[1] In University College Museum is a preparation which illustrates admirably how firmly the larynx may get plugged with a fragment of unchewed meat.

[1] Edin. Med. and Surg. Journ., 1844.

Artificial respiration in infants is to be done differently from any of the modes we have hitherto described. The muscles of the new-born are not sufficiently developed to make the Silvester method effectual; and as for the Marshall-Hall and the manual-pressure methods, in cases of still-birth they are simply impossibilities; for, as the child has never breathed, there is no air in the lungs to expel, either by one or the other method. Even if the child has breathed, the thoracic walls are scarcely sufficiently strong and elastic to enable these methods to be adopted with much prospect of success. In children, at least under six months old, mouth-to-mouth inflation is by far the simplest and most effective mode of artificial respiration.

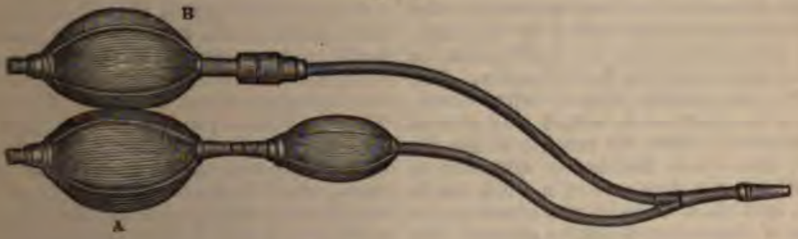
The operation is best performed by placing the child on a pillow on the table, with its head to the operator's left hand. The operator placing himself on a chair, after wiping the mouth and nostrils clean, should seize the larynx between the thumb and forefinger of the right hand, and press it gently but firmly upwards and backwards. This is done with the object of facilitating the entrance of air into the lungs, and at the same time preventing any passing down the œsophagus into the stomach. The nostrils are then closed with the left hand, and the operator proceeds to distend the child's lungs with air by placing his lips over its mouth and blowing steadily into it. Having done so, he removes the hand from the larynx and gently aids in the re-expulsion of the air from the lungs by pressure on the lower part of the sternum. This is to be repeated twenty or twenty-five times in the minute. We have frequently adopted this method, even on premature children, with perfect success. As an example of this mode of procedure, the following case, which to us is one of more than usual interest, may be related:—

In 1850, while house-surgeon to the Royal Maternity Hospital in Edinburgh, we extracted a child by the Cæsarian section after the death of the mother.[1] It was only a seven-and-a-half months' child, and on extraction neither pulsation in the cord, nor the slightest movement of the heart, was perceptible. Mouth-to-mouth inflation was immediately had recourse to, in the manner above described; and after at least ten minutes' labor it succeeded in restoring the heart's action, which was soon afterwards followed by respiratory movements, which, though feeble for a time, soon became sufficiently strong for the purposes of life. After the lapse of nineteen years the individual was ascertained to be still alive, and a fine healthy young man.

It is sometimes no agreeable task to apply the mouth to that of another. In that case a flexible or a metallic catheter may be passed into the trachea, and tightly held there by the finger and thumb placed on the neck, while air is blown through it into the lungs. The only difficulty here is the getting the instrument into the larynx; but that is easy enough if the operator will only remember to take the precaution to push the larynx upwards and backwards, as before described, and then glide in the catheter with its point tilted forwards. The catheter will be known to be in the trachea, and not in the œsophagus, by our capability of moving the larynx from side to side by its means.

Dr. Richardson[2] has proposed a "pocket bellows" for artificial respiration, as represented in the accompanying woodcut.

Fig. 569.



It consists of two elastic hand bellows ending in a single exit tube. When the bellows are in action, the tube being inserted in the nostril, one ball (A), after exhaustion, becomes filled from the common air, and the other (B) from the air left in the air-passages. During compression, the air in the ball charged with common air enters the lungs, and the air in the ball charged from the lungs is driven into the atmosphere. Thus the precise conditions of natural respiration are imitated. The filling and emptying of the lungs is in the grasp of the operator, who can therefore fill or empty gently or forcibly, as he pleases. In using the bellows, it is good to begin by a gentle exhaustion, and the milder the force employed to fill the lungs. the better. Merely to excite thoracic movements is sufficient, and the moment there is spontaneous or natural breathing, it is best to cease the artificial process. In croup and other diseases where the air-passages are obstructed, and the patient is sinking from exhaustion of the muscles concerned in respiration, Dr. Richardson thinks these bellows may be employed with great benefit.

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[1] Edin. Monthly Med. Journ., July, 1850.

[2] Med. Times and Gaz., December 4, 1869.

In cases of apnœa from inflammation of the fauces, excited by drinking boiling water, inhaling steam, or swallowing escharotic fluids, it is better, before attempting artificial respiration, at once to perform tracheotomy. For when the inflammation or disorganization is sufficiently severe to prevent the entrance of air by the natural thoracic movements, it is not at all probable that artificial means will be more successful in surmounting the obstacle to its admission. The same remark is equally applicable to cases of diphtheria and croup.

In cases of attempted death by strangulation, the surgeon may be called upon to treat something else than mere apnœa. If much force has been employed in constricting the neck, there may be considerable injury done to the larynx. The os hyoides may be fractured; the laryngeal cartilages broken, especially in old persons, in whom they have become ossified; moreover, there may be contusion, and even laceration, of the soft parts of the neck. As an illustration to these remarks, the following case of impending apnœa arising from fracture and displacement of the os hyoides may be cited:—

On May 28, 1856, a little girl, aged six years, while jumping, fell with her neck across the rail of an iron bedstead. She was instantly seized with a fit of coughing, great dyspnœa, an inclination to vomit, and a copious flow of saliva. The saliva was partly tinged with blood. When brought to us, which was almost immediately after the receipt of the injury, there was distressing difficulty in breathing, the face was of a livid blackness, and there were all the other symptoms of impending death by apnœa. On examining the neck, there was found a sharp body projecting beneath the skin. It was very angular and quite movable. On close inspection it was found to be the displaced ends of the fractured hyoid bone. One end of the body rode over the other. By a little manipulation the fracture was reduced, and all the symptoms of impending suffocation, together with the copious flow of saliva, etc., rapidly subsided. A bandage was placed round the neck to keep the ends of the bone in their place; and with the exception of a smart attack of fever, which lasted three days, the child made an uninterrupted recovery, and without any deformity except a slight fulness caused by the callus; but even this after a time disappeared.

Where there is much congestion of the vessels of the head and neck, bleeding has occasionally been had recourse to; and although it cannot be recommended as a means of removing apnœa, yet we see no reason for condemning it *in toto*, as some recent writers have done. On the contrary, although we would not advise it to be practised as a general rule, we nevertheless think that the abstraction of a moderate amount of blood from the right jugular vein may be sound treatment in certain cases of apnœa. It will have the advantage of relieving, for a time at least, the congestion in the vena cava superior, and thereby facilitating the contractions of the over-distended and thereby weakened heart. On opening animals immediately after death by apnœa, we have frequently seen the arrested heart's action recommence, and continue regular for at least a quarter of an hour after we had punctured the vena cava and thereby relieved the engorged cardiac organ of some of its blood. The heart is exactly like the bladder; whenever it is over-distended, it ceases to be able to contract upon its contents. In thus recommending bleeding from the jugular vein in certain cases of apnœa, we desire it to be distinctly understood that the abstraction of blood is only to be regarded in the light of an auxiliary to the other treatment, and to be in no case practised except in plethoric subjects; for, in those of an opposite constitution, all the blood they possess is required to carry them through the dangerous period of secondary apnœa.

It has been argued that if bleeding is serviceable at all, it ought to be particularly so in cases of strangulation and hanging, where urgent symptoms of cerebral congestion are frequently observed. No doubt this view is correct; but the bleeding must not be carried too far, for experience has taught that in these very cases, after the first insensibility has been temporarily recovered from, bleeding has neither prevented the supervention of stertorous breathing, convulsions, coma, nor even death itself.

As regards treatment in cases of drowning, we desire to call special attention to the fact, that all persons who die in the water are not necessarily drowned. A man laboring under heart-disease may suddenly expire from the thoracic shock received in coming violently in contact with the surface of the water. Persons falling from a height have died from concussion of the brain and extravasation of blood under the arachnoid.

On the other hand, persons have died of apoplexy while bathing; and not long ago the brother of a medical man died from an epileptic seizure which was supposed to have come on during the act of diving. This occurred in one of our public baths, where he was in the habit of practising swimming. On the occasion in question he was seen to dive, as he usually did on first entering the water; but as he never rose again, a search was made, and his lifeless body was found lying at the bottom of the bath. The gentleman had suffered from epileptic attacks for several years.

While guarding against an error in treatment from mistaking epilepsy for drowning, one must be equally cautious not to fall into the opposite error of mistaking the convulsions of apnœa for those of epilepsy; for they may occur in cases of drowning, as well as in any of the other forms of death from cessation of the respiratory process.

As regards prognosis in cases of drowning. It may be laid down as a rule, that the more complete the submersion the more fatal the case; for after the person is completely submerged, frequent attempts at respiration continue to be made, with each of which air and frothy water are expelled from the lungs, and water enters. This goes on until the person is exhausted and all attempts at respiration cease. For example, a person completely submerged for one single minute and a half has a much slighter chance of recovery than one who has struggled about in the water for ten minutes or more, even although the former when taken out is still making efforts at respiration, and the latter has ceased to do so. Of course it is taken for granted that in the latter case the heart's action still continues, and the respiratory movements have only just ceased. The heart's action continues for from two to four minutes after respiration has stopped; and so long as the impulse of the heart is perceptible, resuscitation is not only possible, but probable.

By referring to the physiology of drowning, the grounds upon which this assertion is based will be at once evident. It may be added, as a second general rule, that the more rapid the cessation of the respiration in cases of drowning, the less is the chance of recovery—which is exactly the reverse of what happens after apnœa from mechanical obstruction. The reason of the greater likelihood of death after a rapid stoppage of the respiratory movements in drowning, is that it usually arises from a very sodden condition of lung; and in proportion as the lungs are sodden with water are the chances of recovery diminished. When the person has gone on struggling for some length of time, and occasional imperfect inspirations have been obtained, he at length sinks from the combined effects of exhaustion and apnœa, and the lungs are not then in the sodden condition met with in cases of entire and continued submersion. This, too, is the reason why the lungs of human beings seldom or never exhibit the excessively sodden condition met with in animals sacrificed for experiment.

The object of suspending drowned persons by the heels for a second or two is to permit of the exit of the water from the trachea and bronchi; and the plan is no doubt, in certain cases, a good one.

As regards the treatment of cases of apnœa from simple absence of oxygen in the inspired medium, we have no special remark to make, except that artificial respiration is the only treatment required.

While regarding the cases of semi-apnœa and semi-poisoning of the fourth group of the classification, we have to observe that, if possible, artificial respiration is more imperatively demanded in them than in any of the other cases we have hitherto been considering, for the simple reason that not only is oxygen required to be put into the circulation, but the poisonous gas to be taken out; and there is no readier means of attaining this object than by artificial respiration. All gaseous and volatile poisons are much quicker eliminated by the lungs than by any other channel. A most striking illustration of this can be given in the experiment first proposed by Bernard, and which we have several times repeated with results precisely similar to those obtained by its inventor.

Sulphuretted hydrogen, when inhaled, is rapidly fatal to animal life; whereas if, instead of allowing the gas to enter the circulation by means of the lungs, it be mixed with water and injected into the jugular vein, it fails to produce any toxic effect. And why? Merely because it is *exhaled* by the lungs during its passage through them, and it is thereby prevented from getting into the arterial current. So rapid is the exhalation of the gas, that if a fragment of white paper moistened with the acetate of lead be held in front of the dog's nose, within four seconds after the injection of the gas into the jugular vein, it reappears in the expired air; as is proved by the black sulphuret of lead which forms on the paper the moment the breath comes in contact with it.

The experiment is sufficient of itself to prove the value of artificial respiration as a means of eliminating volatile poisons from the circulation · so that it is unnecessary for us to enter into the question of the pulmonary elimination of ether, chloroform, or any other volatile vapor or gas; the results obtained by experiments being identical in all cases, as far as they have been yet tried.

In entering a place full of foul air, for the purpose of rescuing some one who has become insensible, a deep inspiration should be taken, and then the breath held the whole time the person is in the poisonous atmosphere; just in the same way, and for similar reasons, as a man fills his chest with air before diving, and holds his breath the whole time he is under water. It might be said that these views are still further supported by the facts discovered by the Committee of the Royal Medical and Chirurgical Society, namely, that while a dog submerged for a minute and a half without being previously chloroformized, dies, a dog, previously rendered insensible by chloroform, may be submerged for two minutes fifteen seconds, and yet recover. It is thus seen that by simply depriving the animal of the power of making voluntary respiratory efforts, the period during which submersion may be continued, and yet recovery follow, is at once prolonged.

It only remains for us now to put before our readers the general rules which should guide them in the treatment of cases of apnœa, the fundamental object which is to arterialize the blood as rapidly as possible. The Royal Humane Society's rules are so admirably drawn up, that we have only to modify them a little in order to give to them the wider application demanded by the general question of apnœa.

Galvanism has been frequently proposed as an aid to recovery in cases of suspended respiration; but as the grounds on which its supposed benefits rest are somewhat vague, they need not be here entered upon. The advantages derivable from the remedy may be summed up in a very few words. In the first place, it is to be borne in mind that artificial respiration cannot be kept up by galvanic influence alone. Galvanism can only be employed as a direct re-exciter of normal respiratory movements and reawakener of the heart's action, when that organ has ceased to pulsate. For these purposes it is best employed in conjunction with artificial respiration; and is most readily applied by placing one pole in the upper sternal or lower cervical region, and the other immediately over the diaphragm. The galvanic shocks ought not to be too frequent nor too prolonged; and when they visibly fail to restore the normal respiratory movements and cardiac action, this agent ought to be laid aside, as its continued use tends to exhaust the vital energies.

RULES OF TREATMENT IN CASES OF IMPENDING DEATH BY APNŒA.

1. All froth and mucus, of which there is usually a considerable quantity, are to be immediately removed from the mouth and nostrils; and should the case be one of drowning, in addition to the removal of the mucus from the mouth and nose, the legs and trunk of the patient are to be raised for a few seconds above the head and shoulders, in order to allow of the exit from the trachea and lungs of any free fluids that may be present in them.

2. All tight articles of clothing are to be at once removed from the neck and chest. For example, the cravat **is to be taken off,** the shirt unbuttoned, **the corset unloosened,** etc.

3. Should it happen **that the patient is** already so **nearly dead** that **his tongue sinks back into the fauces, and is thereby likely to interrupt the entrance of air into** the trachea, **it is to be drawn forward,** and, if necessary, **held there.**

4. If the **respiratory movements have** ceased, or become **few and feeble, artificial** respiration **is to be performed by manual** pressure, or **by the Silvester method.**

N. B. **In order to do this readily, place the patient upon his back upon a flat surface, with the pillow or cushion under** the shoulders, **for the purpose of arching** the back slightly; **and if manual pressure** is the method **adopted, it must not be forgotten** that **the pressure is to be made simultaneously** on the lower **part of the** chest and middle **of the abdomen.**

5. Should the apnœa **be the result of** mechanical constriction **of the chest, as** from a fall of earth **or stones, by which** one or more of the ribs **may have been** broken, the manual pressure **and the ready** methods are to be avoided, **and artificial** respiration **by means of the Silvester** method employed **in their stead.**[1]

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[1] If there be sufficient assistance at hand, the Silvester method may be followed in all cases in which artificial respiration is considered necessary; but where the medical attendant is alone, the method by simple pressure is the quickest and easiest that can be adopted. It only differs from the Silvester method in this respect, that in it the air is forcibly expelled from the lungs, and allowed to enter, in consequence of the vacuum produced in the thorax by the re-expanding of the walls by their own elasticity; while in Silvester's method the air is forcibly inhaled and then expelled by the natural resilience of the ribs. In both cases the respirations should amount to twenty, thirty, or even forty per minute. The natural respirations are only eighteen per minute; but in cases of resuscitation, our object is to arterialize the blood even more rapidly than in health;

6. As soon as natural respiratory movements recommence, cease the employment of artificial means, unless the efforts are feeble and imperfect, when they may still be aided for a time with advantage.

7. As soon as the patient is capable of swallowing—and sooner, if a stomach-pump is at hand—administer a cupful of warm coffee or tea, with a couple of drachms of spiritus etheris nitrici in it; or if that is not at hand, a tablespoonful of brandy or other spirit.

8. Use warm frictions all over the body, more especially on the limbs, to aid the circulation; and the more the skin is exposed to dry warm air the better, as even the cutaneous respiration aids in the arterialization of the blood.

9. When the temperature of the body is much reduced, as in cases of drowning during the cold winter months, try and restore it by means of a hot-water or air-bath. If by the latter, place the head of the patient so as to keep the rarefied hot air from entering the lungs. Artificial respiration by pressure and frictions with the hand can both be readily applied while the body is in the warm bath.[1] The bath should not be too hot (not above 106° F.), as it is not desirable, for the reasons formerly given, to raise the bodily temperature above its normal standard. Nor should the body be retained in it after the temperature has been restored; for, as was before said, the more the skin is exposed to the air the better.

Treatment after the breathing has become natural.—1. Give the patient some warm nutriment, to which a small quantity of stimulant is added; beef-tea, chicken-soup, coffee, or simple tea with one or two tablespoonfuls of brandy.

2. Put him into a well-aired bed with hot bottles to his feet, and encourage sleep.

3. Let him be carefully watched during sleep in case of secondary apnœa; at the slightest symptom of which let gentle frictions and, if necessary, artificial respiration be again had recourse to. Give volatile stimulants, such as the spiritus ammoniæ aromaticus, or spiritus etheris nitrici.

In the case of the drowned, the following might be said to be the four golden rules of treatment:—

1. Empty the air-passages of all the water and frothy mucus they may chance to contain, by holding the legs and trunk higher than the head.
2. Wipe the mouth and nostrils dry.
3. Draw forward the tongue.
4. Use artificial respiration.

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and as we cannot introduce by artificial means the same amount of air that is taken in by the normal efforts, we must increase the number of our respirations.

[1] In the case of a young woman, one of the fourteen who were nearly drowned in the water at the Regent's Park a few years ago, in consequence of slipping into a hole in the ice, the body was so excessively cold, and the limbs so stiff, that as soon as she was brought into the tent which was being used as a temporary receiving-house, she was instantly put into a warm bath, without waiting to take off her clothes, and artificial respiration by manual pressure at once commenced. It was, however, found impossible to obtain any result with her stays on; so they were slit open, but not removed, and the artificial respiration at once recommenced. In about twenty minutes the patient was so far recovered as to be able to give her address. In this case, when brought into the tent, the girl appeared to us to be perishing as much from the effects of cold as from apnœa.

PART II.

DISEASES OF THE BONES JOINTS, AND MUSCLES.

DISEASES OF THE BONES.
EXCISION OF THE BONES.
DISEASES OF JOINTS.
DISEASES OF THE SPINE.
ORTHOPÆDIC SURGERY.
AFFECTIONS OF THE MUSCULAR SYSTEM.

PART II.

DISEASES OF THE BONES, JOINTS, AND MUSCLES.

DISEASES OF THE BONES.

By T. Holmes, Esq.

Revised by Thomas M. Markoe, M.D.

Diseases of the bones may be conveniently divided into the following classes: —*First*, inflammation and its consequences: under which head it is proposed to include the varieties of the inflammatory process, which have received the names of periostitis, osteitis, and osteo-myelitis; and, as consequences of these, all the numerous conditions which have been confounded together under the common but vague designation of caries, the various forms of suppuration in bone, the varieties of necrosis, its effects, and those processes of repair which result in permanent modification of the structure and form of the organ. The *second* class will include the specific diseases, which occur either as modifications of the inflammatory process—syphilis, scrofula, and rheumatism in bone—or as constitutional conditions leading to changes in the bony structure; such are, mollites ossium, rickets,[1] and cancer. The *third* division will comprise a description of the various new formations found in the osseous system, and which are not dependent on any of the known constitutional cachexiæ. The *fourth* will treat of atrophy and hypertrophy properly so called, *i. e.*, uncomplicated by inflammation.

Simple Inflammation and its Consequences.

Inflammation of bone differs from inflammation of soft parts, not in its essential, but in its accidental features; the inflammatory process is the same, but the conditions and circumstances are different, and hence arise diversities in rate of progress, in external appearance, and in other symptoms; diversities which, although they are not really essential, yet cause striking differences to ordinary observation, and have led to the designation of the results of inflammation in bone by names differing from those which are used for the same changes in soft parts. This difference in nomenclature, though it might arise in mistake, at a time when necrosis was thought to be something essentially different from gangrene, and caries a disease which had little in common with ulceration, is yet hardly to be regretted, since the diseases of bone, though pathologically identical, are practically very different from those of soft parts; and it is convenient to have separate names for things which require very different treatment, and entail a very different amount of danger.

If the reader will consult the appendix to the essay on Inflammation in Vol. I. of this work, he will find abundant information on the early steps of that process. These affections are identical in bone and in soft parts; in fact, they can occur only in the soft parts of bones, since the mere inorganic matter, which, involved in the convolutions of a cellulo-fibrous and vascular network, constitutes a bone, can itself be the seat of no vital actions, but must obey the movements impressed upon it by the living textures around.

In Von Bibra's essay *On the Decomposition of Bone by Caries*,[1] will be found a good deal of interesting information on the chemical and microscopical characters of bone inflammation; and from this author's researches it appears clear, that the changes in the inorganic constituents of bone are often limited to the dissolution of that connection which previously united them to the organic matrix, so as to form one system. This connection having been severed, portions of the salts are washed away in the discharges, and they may be found, according to Von Bibra's account, in unaltered chemical composition, while the composition of the organic constituents of the same part is profoundly changed, principally by that fatty degeneration which occurs in all inflammations. The inorganic constituents must, however, in some cases of inflammation undergo other changes, since they may disappear in large masses, without any discharge having been present. Thus in caries of the spine, or in inflammation excited by the pressure of tumors, it is not rare to find that large portions of the vertebral column have been removed, sometimes to such an extent as to expose the spinal canal; yet no abscess has formed. The older pathologists made a distinction between these cases and those of caries, founded on the presence of pus in the latter, and its absence in the former; but this distinction, though of great practical importance, does not indicate any pathological difference. Both are inflammatory processes, though of different degrees: the one, ulceration attended by suppuration; the other, ulceration attended by liquefaction only. From this fact of the disappearance of masses of hard tissue, without any discharge in which they can have been washed away, it seems clear that the small earthy particles thus loosed from their natural connection with the organic matrix may undergo a reversal of the process by which they were deposited out of the fluid blood; *i. e.*, may become again soluble, and pass into the venous current.

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[1] The subject of rickets, however, will not be found here, as it has been thought better to refer it to the Surgery of Childhood.

[1] Liebig und Wohler's Annalen, vol. lvii. It will be found useful to compare this essay

The earliest microscopical change[1] is an unusual fulness and distinctness of all the vascular cavities of the bone; the Haversian canals, lacunæ, and canaliculi being all more sharply marked than in the natural state. This Von Bibra compares to the injected condition of soft parts. Later on, the Haversian canals and lacunæ become widened; the latter disappear in consequence of the communication of neighboring cavities, and spaces are formed in the bone, filled with fat and earthy salts, the detritus of the decomposed tissue.

The earliest change in the consistence of bone, produced by inflammation, appears to be softening; as a consequence of the loosening and absorption of the mineral portion, and the liquefaction and conversion into fat of the organic matrix. Mr. Barwell has published an interesting essay "On Osteitis,"[1] which affords, perhaps, the most distinct demonstration of the enlargement of the vascular spaces at an early period of inflammation. In this essay, Mr. Barwell teaches that the earliest stages of inflammation are accompanied by induration; an assertion which I venture to question, since it appears to me that induration is a phenomenon subsequent in order to the inflammatory process in its stricter sense, and due to one of its results, viz., effusion. The reader is referred to the original essay, which will well repay perusal.

Such are the earliest changes in the minute structure and consistence of inflamed bone. The changes which take place in its rough anatomy may be thus described. If a bone be examined at an early period of inflammation (the ordinary and most accessible is the stump of the bone in an amputation fatal, say, three weeks after the operation),[2] the periosteum will be found somewhat thickened, vascular, and not so closely connected to the bone as usual.[3] If the periosteum be stripped off, the bone is seen to be irregularly vascular, some portions of it having a slightly red tint, and contrasting with the healthy white color of the rest of the bone. This red tint is evidently caused by the enlargement of the vessels which pass from the periosteum into the bone; and if a magnifying-glass be used, the increased size of the vascular apertures is easily proved, while if pressure be made on the surface of the bone, drops of blood will frequently ooze from the mouths of the enlarged vessels, proving their increase in size, as well as the loss of consistence in the outer hard wall of the bone. At the same time there will be found, in all probability, on some other part of the surface, more or less deposit of osseous matter, which, with the partial separation of the periosteum above mentioned,

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with those of Mr. Barwell and Dr. Black, referred to further on.

[1] See Von Bibra, op. cit.

[1] Brit. and For. Med.-Chir. Rev., April, 1860, pp. 460 et seq.

[2] In such a specimen the periosteum will generally be found stripped off from a small ring at the lower end of the bone, and this part will perhaps be dead or about to die; but as this feature is accidental, it will not be further noticed.

[3] Hunter has put up (Mus. Coll. of Surg. No. 656) "A preparation of a femur, which was amputated, with the periosteum separated; to show how clear the periosteum separates from the bones in inflammation; a fact almost always observable after amputation."

testifies to the fact of effusion from the vessels of that membrane. In these simple cases of injury the deeper parts of the bone will probably be unaffected; but should this not be the case, *i. e.*, should inflammation have also attacked the membrane lining the medullary cavity and cancelli, that membrane will be found in a condition essentially analogous to that of the periosteum, although the different situation of the medullary membrane, and the great quantity of fat and other loose tissues among which its vessels run, will somewhat modify the external appearances. If, however, these appearances be minutely investigated, they will be reduced to: increase in the number and size of the vessels, and effusion of blood, lymph, or pus, according to circumstances. The thickening both of the periosteum and of the medullary membrane is sometimes considerable. The former membrane is, of course, more frequently found thickened than the latter; but preparations showing the participation of the medullary membrane in inflammation of the bone, and the identity of its appearance with that of the thickened periosteum, are not wanting.[1]

Thus we see that when inflammation commences, as it usually does, on the surface of a bone, whether periosteal or endosteal, its primary symptom is increase in the size (and perhaps number) of the capillary vessels, or vascular spaces, and effusion of blood or lymph. The primary effects of inflammation in the central parts of the compact tissue are similar to the above; though here, from the different circumstances in which the vessels are placed, this similarity has been less distinctly perceived; and from the slowness with which all changes go on in the compact tissue, opportunities rarely occur of comparing the different parts of the same bone with each other. The first change is the enlargement of the vessels which run in the Haversian canals; but effusion is a much later phenomenon, and is preceded by the absorption of the bony tissue which adjoins the enlarged vessels; so that in microscopical sections of inflamed bone, the Haversian spaces are seen much enlarged, irregular, eroded, and sometimes almost, or quite, communicating with each other. The lacunæ may also be noticed to be densely crowded together, and sometimes the granular matrix of the bone appears more coarse than natural. When this absorption of the walls of the Haversian canals becomes visible to the naked eye, the first change in the rough anatomy of inflamed compact tissue becomes appreciable—that in which spaces are seen in it on section like those in cancellous tissue, so that it is sometimes said to become cancellous. Similar changes occur in the cancellous tissue itself, whereby its cells become much enlarged, and sometimes the whole bone is expanded by the simultaneous yielding of its walls.[1]

[Cornil and Ranvier say that "the first change in a bone upon which artificial irritation has been employed is the formation of embryonic cells in the medullary spaces, in the Haversian canals, and under the periosteum. These cells resemble those which fill the primary medullary spaces during the development of bone from cartilage, or those which are found under the periosteum while the bone increases in thickness. Irritation of a bone results, then, in its return to an embryonal condition, and herein we find an application of the general law which governs the irritation of any tissue."

O. Weber and Volkmann consider the absorption of osseous tissue to depend upon a fatty degeneration of the bone corpuscles. Billroth asks, "Is there such a thing as inflammation of the bone substance proper?" and answers the question in the negative, chiefly because he considers the physical conditions of compact bone incapable of swelling, and other changes which, as he considers, must characterize all real inflammations.]

Into the spaces thus hollowed out in the substance of the bone, or on its surface by the removal of the earthy matter, the products of inflammation are next secreted. These secretions vary, of course, according to numerous preceding circumstances, *e. g.*, the nature of the injury, or other cause of inflammation, the activity of the process, the constitutional condition of the patient, and a thousand others; and so the products of osteitis are divisible into two principal varieties, corresponding to the plastic and aplastic lymph met with in other parts, and leading, the former to the deposition of earthy matter and the formation of new bone, and the latter to suppuration. The former result terminates in hardening, or *sclerosis*, as it is termed; the latter in a variety of conditions: when the suppuration is limited within a cavity in the cancellous tissue, or in the compact tissue rarefied by previous inflammation, *circumscribed abscess* is produced; when the pus extends along the inner surface of the membrane lining the medul-

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[1] One of the most striking preparations of this kind is in the museum of St. Bartholomew's Hospital—a humerus; series i., 207.

[1] See a description, by the author, of the bones of the lower extremity ten months after excision of the knee, where the superficial laminæ of the femur had been so separated from each other by inflammation that the bone crackled under the pressure of the finger. Path. Soc. Trans., vol. xii., p. 171.

[illegible] inflammation of the [illegible] the death of larger [illegible] of gangrene, is often [illegible] inflamma- [illegible] of necrosis must [illegible]

[illegible] separately the causes, [illegible] and treatment of each of these [illegible] of the inflammatory process [illegible] intended only as a sort of ground-plan to mark out the various parts of a rather intricate subject, each of which must be studied in detail.

Osteitis.—Inflammation of bone is excited [illegible] by external violence, or exposure to cold, acting upon a constitution predisposed to the disease. The chief predisposing causes are the syphilitic or scrofulous taint, rheumatism, and defective nutrition; or these may themselves set up inflammation in any bone, without a distinct exciting cause. From this mode of causation it follows, that the bones most liable to inflammation are those most exposed to the action of external agents. Hence we see it most frequently in the tibia among the long bones, and in the skull, sternum, and ribs among the flat bones. The bones of the foot and hand are also very frequently affected.

Osteitis is a very common affection, although not much recognized; partly because, from the little attention it has received from our older authors, and from the fact that most swellings of bone are regarded as periosteal, we are not much in the habit of looking for it; and partly because its symptoms are at first obscure, and liable to be masked by those of the injury to the soft parts with which it is associated, or of the constitutional affection from which it springs.

The symptoms vary according to the stage of the inflammation. In the first stage, that in which the size of the vessels is increased, and in which absorption is being produced, the disease frequently makes considerable progress without appreciable symptoms.[1] Sooner or later, however, the occurrence of those characteristic pains in the bones, exacerbated by changes of weather, increasing in severity during the night, and somewhat resembling the pains of rheumatism, which are described by French writers as "douleurs ostéocopes," draw the attention of the patient to the seat of the disease, and form a valuable guide to the surgeon. If the part be now examined, the probability is that some evidence will be found of inflammation in the tissues surrounding the bone—œdema, redness of the skin, tenderness of the soft parts, or threatening abscess. The absorption of the earthy material which accompanies this increased vascularity, manifests its effects upon the bone by a diminution in its consistence, and then the bone becomes at the same time increased in volume and diminished in its resistance to pressure. The former symptom is indeed somewhat delusive, since the apparent increase is often due principally to enlargement of the soft parts. Thus, the expansion of the joint-ends of bones, which frequently appears so considerable in chronic affections of the joints, is often reduced to a hardly appreciable enlargement on dissection. But the swelling of the bone may sometimes be made out very clearly, and is then a valuable indication of the disease. The softening is not generally of much importance as a diagnostic symptom; it rarely affects the whole thickness of a bone, so as to lead to a change in its form, and, when limited to a portion of the surface, cannot be appreciated by the touch, since the inflamed and irritable condition of the soft parts renders the patient unable to bear the necessary pressure.

A singular change, which sometimes follows inflammation of a long bone, is its elongation. Dr. Humphry has laid much stress upon the consequences of diseased conditions of the epiphyseal lines near the ends of long bones, as affecting their subsequent growth.[1] It is possible that inflammation of this tissue may have led to the elongation of the bone in some of the cases; as in a tibia from a lad aged eighteen, preserved in the Museum of St. Bartholomew's Hospital, in which the bone has become lengthened, and is curved in order to adapt its length to that of the healthy fibula.

[The elongation of bone, as a consequence of inflammation, sometimes leads to errors when, in injuries of the limbs, accurate measurements are required. The history of the case will generally explain any discrepancy which may be found, and should always be appealed to. Another fact which weakens confidence in measurement of the limbs is found in the inequality in length of the limbs of persons in whom no previous accident or disease has existed.

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[1] This is true more especially of the earlier stages, but is occasionally observed in all periods of inflammation of bone. Thus large psoas abscesses, connected with extensive erosion of the vertebræ, are found sometimes in patients not of a strumous habit, and who have not been known to present any symptoms of such an affection.

[1] Med.-Chir. Trans., vol. xlv., p. 294.

Drs. Cox, Hunt, and Roberts, of Philadelphia, have shown, by careful measurement of large numbers of patients supposed to have perfect limbs, that great inequalities exist in the length of the two limbs; in fact, that perfect equality is rather the exception than the rule. These observations on living persons have been amply confirmed by Dr. J. G. Garson, Anatomy Assistant at the Royal College of Surgeons, London, who has measured the lower limbs of seventy skeletons, and found them equal on the two sides in only about ten per cent. of the whole number examined. The extent of the variation was about an average of 4 mm., not confined to any age, sex, or race.]

Fig. 570.

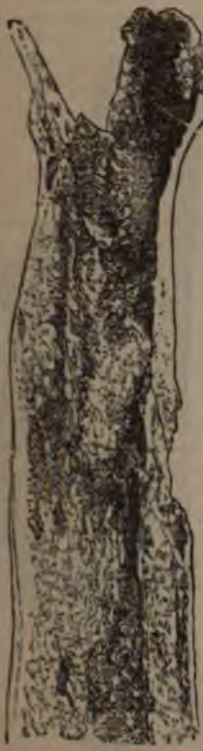

Fig. 571.

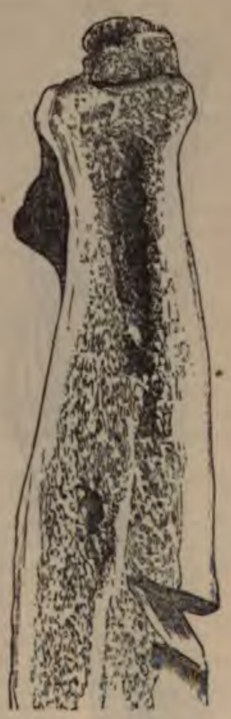

Fig. 570.—(From a preparation in the Museum of the Royal College of Surgeons, No. 3085, to illustrate the rarefying stage of osteitis.) The tibia in this case weighed 9 ounces.

Fig. 571.—(From a preparation in the Museum of St. George's Hospital, series ii., 19, to illustrate the termination of osteitis in condensation or sclerosis.) The tibia in this case weighed 19 ounces.

To the stage of absorption and rarefaction succeeds that of effusion and deposit, unless the process be arrested, and resolution occur. The various consequences of suppuration enumerated on p. 121 being reserved for subsequent sections, we need now only consider that termination of inflammation of bone in hardening or sclerosis, which corresponds to the inflammatory solidification of parenchymatous organs; and which, when not too extensive, is for practical purposes little less desirable than complete restoration to health. The interstices of the cancellous tissue are filled up at first with lymph, in which ossific matter is afterwards deposited;[1] and then the bone, which, while actively inflamed, had been less dense than in its healthy condition, as in fig. 570, becomes hard, heavy, and solid, as in fig. 571; the medullary canal is narrowed or filled up, and the shaft thickened by deposit from the periosteum. Bones thus affected abound in every pathological collection; and it is easy to trace in them many of the appearances of which an explanation has been attempted above—the large size of the vascular apertures, the irregular deposit of bone, both in the centre, the substance, and on the surface of the shaft, the contraction of the medullary cavity, and usually the increase in size of the nutrient foramina. It will generally, but not always, be noticed that these changes are limited to the shaft of the bone, when it is the part first affected, and that the articular ends escape. The converse is also usually the case; though perhaps the shaft is more prone to become involved in the morbid actions of the joint-ends than the joint-ends are in those of the shaft. Thus inflammatory affections may long go on in the shaft of the femur, yet the knee-joint remain unaffected; and, on the other hand, where disease of the joint commences in the articular ends of the bones, the shafts usually are unaffected, and the disease of the bones considered by itself is not so extensive as to contraindicate excision. To each of these two general rules, however, numerous exceptions will, unfortunately, be met with in practice.

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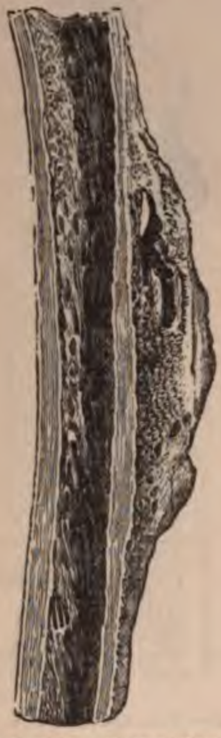
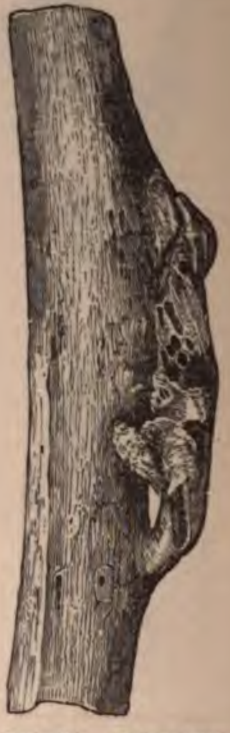
[1] An instructive case is related by Mr. T. Smith, in Path. Soc. Trans., vol. xviii., p. 218, of an amputation in a case of chronic ostitis of the femur. "The shaft of the femur was somewhat enlarged, but its texture was greatly condensed and indurated. The cancellous tissue of the lower end of the bone was plentifully infiltrated with lymph in various stages of disintegration, being apparently purulent about the epiphyseal line.

Fig. 572.



Periostitis. (Internal view.)

Fig. 573.



Periostitis. (External view.)

Two drawings from a preparation in St. George's Hospital Museum, to illustrate the ordinary anatomy of periostitis.

Inflammation of the bone is almost always known, in common parlance (when it is recognized at all), as *periostitis;* but in truth, periostitis seldom occurs uncomplicated, unless in the course of secondary syphilis;[1] and almost all the cases which pass under that name are really inflammations, more or less extensive, of the bone.

[It is generally conceded by writers on

The lymph was especially abundant towards the articular end of the bone, where it extended up to and beneath the articular cartilage, which latter was in parts removed by ulceration."

[1] I would refer the reader to the section on Syphilis in Bone for further details on the subject of chronic periostitis.

this subject that inflammation of a bone is never entirely confined to one or other of its constituent parts, but that it is always an affection of the bone as a complete organ, the inflammatory changes predominating, sometimes in one and sometimes in another of these constituents, and hence the terms osteitis, periostitis, myelitis. Gosselin, in his elaborate article in the Dictionnaire de Médecine et de Chirurgie Pratique, says: "A long observation has taught me that, in pathology, these three parts, the periosteum, the bone, and the medulla, already so closely associated in their functions, are identified (solidaires) one with another, affected by the same morbid causes, and in effect, become diseased simultaneously, though in different degrees." This view of the essential association of the different forms of bone inflammation will serve to throw much light upon difficult questions in bone pathology, and is undoubtedly based upon correct observation; nevertheless in practice it is convenient to recognize both pathological and clinical differences between osteitis, periostitis, and myelitis.

These pathological views are well illustrated by a case reported by Dr. H. B. Sands to the New York Pathological Society in 1871. A healthy boy, nine years old, was attacked with severe pain in his thigh, with some tenderness. This continued for a day or two, then fever developed, the temperature rising to 103.° On the fourth day he was delirious at night, with a pulse of 104 and feeble, the tongue dry, and great constitutional depression. The tenderness had now diffused itself along the whole thigh, deep pressure giving pain. There was no effusion into the knee-joint. There was no apparent swelling of the thigh, and he was able to move it with some freedom. Careful measurement showed the diseased left thigh to be an inch larger than the right. The pain was paroxysmal and very severe. On the fifth day he was much worse, delirium incessant, pulse failing, temperature high. The thigh was now swollen, but not œdematous. He died on the morning of the sixth day.

On post-mortem inspection the thigh measured two inches more than the sound one. The muscles were somewhat infiltrated, but no inflammatory signs appeared till the periosteum was reached. The outer surface of this membrane throughout nearly the entire shaft of the femur was surrounded by pus, accumulated in greatest quantity at a point above and at one below, on the outer aspect of the thigh. The periosteum was the seat of an acute œdema, and separated more readily than it should from the subjacent bone. On raising it from the bone, there were seen some small deposits of pus here and there, lying between the attached surface and the bone; but these deposits were not in so large quantity as those on the external aspect of the membrane, which itself was not at any point perforated. The hip and knee-joints were unaffected. On section of the bone the whole marrow was found to be hyperæmic. In some places it appeared very soft and presented patches of a whitish-yellow color, due to diffluent purulent material. This condition of the medulla extended up to, but not at any point beyond, the epiphyseal line. On microscopic examination the pus-like deposits were found to be mainly composed of closely aggregated small roundish cells, smaller than pus-corpuscles, pale, very finely granular, without nuclei, embedded in an extremely viscid granular substance. The bright-red pulp of the marrow of the shaft presented a much smaller proportion of cells similar to those described, a greater amount of fat and granular matter, and was gorged with blood.

This case shows that in an acute attack of osteitis, lasting only six days, the inflammatory process was nearly equally developed in periosteum and medulla; and leaves the reasonable inference that the bone substance itself was as much and as deeply involved as its structure permitted it to be in the acute processes which surrounded it, illustrating, though perhaps not proving, the pathological oneness of the three constituent structures of the bone.

That inflammation may thus pursue its course more fully developed on the side of the periosteum or of the medulla, is of course perfectly understood. That it does thus go through its chief manifestations in the bone-tissue itself, is a pathological rarity. Of this, however, Lidell gives one case which he presents in elaborate detail, in the concluding of which he says: "The healthy condition of the medulla in this case, and the small amount of disease of the periosteum, show conclusively that this was an instance of primary inflammation of the bone itself." He states that it is the only case of the kind that he has seen.]

That this is so, will hardly be doubted by any one who considers how few preparations of pure periostitis can be found in our museums, and how seldom, during our post-mortem examinations, we meet with periostitis unattended by inflammatory deposit in the deeper parts of the bone. The symptoms, as well as the morbid anatomy, of both are identical, only that in periostitis the thickening and vascularity involves no other part of the nutrient membrane of the bone except the periosteum, and that the inflammatory deposit is confined to the surface of the bone, between it and the periosteum. Periostitis is a quicker process, and one more under the influence of remedies than the other forms of inflammation of bone; but in all the same general course of treatment is indicated, viz., the internal administration of iodide of potassium, and the local application either of iodine or mercurial ointment, or, in the early stage of the disease, of blisters. These measures should be combined with proper position of the affected member, and as much rest as is consistent with attention to the general health. Leeches or cupping will afford relief if the pain be severe. When there is much tension over the bone, sometimes accompanied (especially in the cranium) with intolerable pain, nothing gives such immediate and decided relief as a free and bold incision down to the bone. The distended periosteum is thus relaxed; and in cases of pure periostitis such a measure may of itself almost suffice for the cure of the disease; but its beneficial effects will be decided, though less striking, in cases of deeper-seated inflammation. In cases of chronic inflammation of bone, accompanied by deep-seated and wearing pain, an opening made with a trephine, for the evacuation of pus, has proved beneficial, even though no pus was found.[1]

Whether the sclerosis or induration, which is the final result of chronic inflammation, be amenable to any remedial measures is doubtful, since it usually gives the patient little inconvenience, and therefore is not made the subject of treatment. Thickening over the bone is often left after osteitis, and is often dispersed by the ordinary measures, such as friction and pressure; but the seat of this thickening is very generally in the soft parts around the bone, and not beneath the periosteum.

Diffuse periostitis.—Inflammation of the bony tissue itself is rarely acute, and when it does occur in the acute form passes rapidly into necrosis, under which head it will be presently spoken of; but acute inflammation between the bone and periosteum, *diffuse periostitis*, is a disease of rather frequent occurrence, and is less noticed in surgical works than its importance would seem to require. It is seen commonly enough in persons about the age of puberty; more frequently in boys than in girls; usually as the result of some injury, and almost always in one of the long bones. It is so destructive in its effects, so rapid in its course, and is so little recognized, that we have unfortunately numerous opportunities of verifying its existence after the time for treatment has passed away; yet to early and vigorous treatment it is tolerably amenable, at least as amenable as so acute a disease can be expected to be.

The pathology of the disease appears to consist in the partial separation of the periosteum from the bone, by effusion on the surface of the latter of lymph, or other products,[1] soon giving place to a copious formation of pus, which spreads along the whole bone, and dissects away the periosteum from it, often from one end of the bone to the other. If examined at an early period of the disease, the periosteum does not (at least it very often does not) display any distinct signs of inflammation, either in change of color or of thickness; nor is the surface of the bone visibly inflamed. On the contrary, it usually looks white, and inclined to gangrene, a consummation which rapidly impends over such cases. Sometimes, however, the surface of the bone may be found slightly worm-eaten, and on squeezing it, its superficial layers are found more readily separable from the deeper tissues than in health; large drops of blood can in such instances be pressed out of the vessels which pass into the bone from the periosteum. A little later, and necrosis is unmistakably declared, and the whole diaphysis usually perishes, leaving the articular ends unaffected, and therefore not involving the neighboring joints.

The joint, however, does not always escape. A girl aged fifteen was admitted into hospital four days after an injury, with great swelling of the fore-arm, evidently depending on the formation of matter. A grating sensation, perceived on rotating the hand, together with the history of the accident, led to the belief that fracture had occurred. She died of pyæmia; and then it was discovered that a periosteal abscess, extending from the shaft of the radius into the wrist-joint, had so eroded the articular cartilages as to occasion the sensation of crepitus.

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[1] See a case reported by Sir B. Brodie, in his Lectures on Pathology and Surgery, p. 410. On the good effects of a free incision of inflamed periosteum, when milder measures fail, see Sir P. Crampton "On Periostitis," Dublin Hospital Reports, vol. i., p. 331.

[1] The disease does not commence by the formation of abscess; often when the swelling and inflammation are considerable, no pus will be found. Of this fact the following is an instance. A lad was suffering from what was supposed to be diffuse cellular inflammation around the ankle after a slight injury. As it was suspected that the inflammation was really subperiosteal, an incision was made down to the tibia. No pus followed. Two days afterwards the boy presented obvious symptoms of confined matter, and now by breaking up the adhesions of the wound a copious evacuation of pus was obtained, and the surface of the bone was felt exposed. A few days later, swelling and tenderness were found over a higher part of the tibia. Thinking that on the former occasion I might not have divided the periosteum freely enough, I now took care to press the edge of the knife firmly against the bone for some distance. Matters went on exactly as in the former wound. No pus was found at the time, but on breaking down adhesions, two days later, with a probe, the pus was discharged, and the bone felt exposed.

The course of the disease is usually as follows: it commences in the great majority of cases with an injury of more or less severity, occurring to a person generally of the strumous constitution, at any rate a weakly person; the symptoms which immediately follow the injury are usually slight, so that even the occurrence of the accident is perhaps nearly forgotten; then, after a varying lapse of time, probably four or five days, symptoms occur which are almost invariably attributed at first to diffuse cellular inflammation, or to acute rheumatism, viz., rigors, pain in the part, and an œdematous angry swelling. At the outset the diagnosis is not easy; indeed, before suppuration has occurred, perhaps no certain diagnosis can be made. However, as respects diffuse cellular inflammation, the age of the patient, the comparative remoteness of the cause, and the previous immunity of the superficial parts, will lead to a suspicion of the nature of the case, which will be strengthened when the inflammation is seen to be limited to the section of the member first affected, instead of passing the joint, and spreading up the limb, as an erysipelatous affection would in all likelihood do, and will be converted into certainty by the discovery of deep-seated matter, either by fluctuation, or on puncture. Fluctuation cannot always be detected, since the tension of the membranes which bind down the pus, and the tenderness of the superficial parts combine to oppose its discovery. Exploratory punctures, however, should never be neglected. If the disease be merely superficial, they can do no harm; and it is of vital importance to discover early, and give instant exit to, the pus before it has dissected off large portions of the periosteum, and involved the death of a great part of the bone. The diagnosis between a case of this sort and one of acute rheumatism will depend upon the nature and history of the disease, and on the presence or absence of constitutional symptoms of rheumatism, or rheumatic affections of remote parts. At the outset of the case the diagnosis may not be very confident; but the main point to recollect is, that any periosteal affection, if acute, is liable to run early into suppuration, and that in such cases, whatever view may be taken of the origin of the disease, whether it is to be considered rheumatic or otherwise, the local treatment is far more important than the constitutional. What Sir P. Crampton says of the acute periosteal whitlow applies with much greater force to acute periosteal affections of the larger bones: "there are few diseases where art can do so much and nature so little."

If the disease be allowed to go on unchecked, the whole circumference of the limb will become greatly swollen and œdematous, usually with that tense glistening aspect which tells of subjacent suppuration. The patient mostly complains of great pain, especially acute at night; he loses appetite and flesh rapidly. Pyæmia is very likely to occur, and many of these patients die of it. A few die exhausted by the violence of the action, and by the profuse suppuration. If the patient survive, and the abscess do not obtain a free and depending opening by timely incisions, it will burrow among the muscles, and ultimately numerous openings will form, exposing necrosed bone. The dead bone appears to separate much sooner than in other forms of necrosis, and the repair to be proportionally active. Thus, in an adult, almost the entire length of the shaft of the ulna was thrown off and removed three months after the injury which led to the complaint; and, even at that date, the repair appeared to be far advanced. In less acute cases, where only a portion of the surface of a bone is involved, the disease pursues the ordinary course of necrosis.

The subjects of this affection are almost always young persons,[1] in whom the strumous diathesis is well pronounced, but it occurs more rarely in healthy subjects about the age of puberty, or even earlier; and some cases are observed (as the one to which allusion has just been made) in adults of impaired constitution and dissipated habits.

The bone affected is, in the great majority of cases, the femur or tibia; and it is no doubt in consequence of the great size of these bones, and the severe effects which always attend upon a large abscess situated below the fascia, that the disease is so fatal. But reference has already been made to two cases in which the bones of the fore-arm were attacked; and any of the long bones may be the seat of the disease, and not unfrequently is so. The flat and irregular bones are more rarely affected; but Sir P. Crampton's case[1] is well known, in which an acute abscess formed beneath the periosteum of the bones of the nose and cranium on both sides. A well-marked instance of acute periosteal abscess of the sternum is described in the Path. Soc. Trans., vol. xv., p. 181, and another less clearly described, but probably of the same nature, in vol. iv., p. 61, of the same series.

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[1] Chassaignac says that, out of eleven cases, only one had passed the seventeenth year, and was below twenty-one; and one was only eleven months old. In the Path. Soc. Trans., vol. vi., p. 284, a well-marked instance is recorded at the age of eleven days. A circumstance which seems to testify to the effect of a constitutional predisposition is mentioned by Chassaignac, viz., that in some cases several acute periosteal abscesses have been present in the same subject.—Mém. de la Soc. de Chir., vol. iv., pp. 286–87.

The treatment of acute periosteal abscess is a matter of the greatest importance, as it is only by vigorous measures that so rapid and dangerous an affection can be relieved. Among these measures, the first and most important is to make timely and sufficient incisions into the swelling. If doubts exist as to the nature of the swelling, or as to the situation of the pus, they will be settled by the grooved needle; but even if no pus be found, it is better in any case of acute periosteal inflammation, where the pain is great, to make an incision down to the bone in the part to which such pain is referred. In children, it will be advisable to administer chloroform before commencing the examination when the affection is deep-seated.

Periostitis sometimes occurs in a sub-acute form marked by rapid swelling around the bone, and by a certain amount of aching pain, but without the severe constitutional symptoms which accompany the graver disease. Incisions should not be made in these cases, unless the surgeon is sure that matter has already formed. The free application of leeches and local warmth will often obviate suppuration; and many surgeons have much confidence in iodide of potassium in full doses, as a remedy in this sub-acute form of the disease.

During the acute stage of a periosteal abscess, free exit having been obtained for the matter, the patient must be treated on general principles; no special internal treatment is necessary for the affection of the bone. The indications are, to allay pain, to support the strength, and to avoid, if possible, the constitutional affection which leads to pyæmia. The last is the most important of all; patients seldom die of the "surgical fever," so-called, which is usually present; they seldom die of the exhaustion of the discharge; but they die by pyæmia in a large percentage of the cases. How great the mortality is, it would be difficult to say, since the disease is not generally recognized in our hospital nomenclature; but out of a comparatively small number of cases which have occurred during the last few years in the surgical wards of St. George's Hospital, a very large proportion have died of pyæmia. Free and early incisions give the patient the best chance of escaping this fatal complication. No fear need be entertained of decomposition of the pus from the admission of air. In fact, pus which is confined over a bone in an acute inflammatory disease, will probably be already sufficiently putrid. The openings should at first be made in as depending a position as possible, and they should be so free as to preclude all risk of their closing again. After the opening of the abscess, free stimulation is generally, if not always, necessary. The patient will, perhaps, be unable at first to take solid nourishment, since these affections are generally attended with severe fever; but as soon as the evacuation of the matter has removed some part of the irritation, his appetite will probably return.

In abscesses which are at once deeply seated and small, it may sometimes be advisable to use a drainage-tube; but in most cases the collection of matter is too extensive to allow of this treatment being beneficially adopted, at any rate till a later period of the case, when the abscess is contracting and the incisions show a tendency to close. In the memoir of M. Chassaignac, already referred to, the author speaks highly of the advantage of injections of very dilute hydrochloric acid, which have the effect, according to him, not only of cleansing the suppurating cavity, but also of hastening the removal of superficial exfoliations by dissolving the dead bone.

If the patient has survived the acute stage of the disease, the abscess may long remain in a chronic condition, exposing the bone. In the more favorable cases, the outer shell only of the latter has perished; while in the most severe, the entire shaft, separated from the epiphyses, may come away in a mass; or even the epiphyses themselves may share in the destruction, though that is not often the case. The treatment of these sequelæ of diffuse periostitis will be spoken of in the section on Necrosis, where also will be found discussed the subject of subperiosteal resection for acute disease.

Osteo-myelitis.—Diffuse inflammation, and suppuration, in the cancellous tissue, an affection to which French pathologists have given the name of "osteo-myelitis," is more frequently recognized in post-mortem examinations than at the bedside of the patient. The more acute and more extensive cases of this affection are closely allied to pyæmia, and are usually, or at any rate very frequently, followed by that mode of death. It bears the same relation to the medullary tissue as the complaint just spoken of does to the periosteum; but the difference in character between the periosteum and the medullary tissue, the latter being so much more rich in vessels, especially in large patulous venous channels, gives to osteo-myelitis a gravity even beyond that of diffused periostitis. It is well known how often diffuse suppuration is found in the diploë of the cranium after scalp-wounds, and how the "puffy tumor of Pott" is frequently only the sign of such suppuration; and further, in what a large percentage of such cases evident pyæmia is found. It is probable that in all these cases the external table of the bone has been wounded, and the diploë thus exposed; in fact, the only known cause of osteo-myelitis is a wound which exposes the cancellous interior,[1] or an injury to the interior of the bone, perhaps unaccompanied by external wound, as in fracture. It is a frequent cause of death after amputations and other surgical operations in which bone is divided.

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[1] Dublin Hospital Reports, loc. cit.

When a bone is examined in which osteo-myelitis has run an acute course, the cancelli are found loaded with pus, and the medullary tissue usually injected and often sprinkled with ecchymoses; the periosteum also is often in the course of separation from the bone; but the bony tissue itself does not generally show any appreciable change. In the larger bones the disease usually terminates fatally at this stage; but should the patient survive, the pus may penetrate into neighboring parts, most probably into the nearest joint, or central necrosis may result.

Specimens to show either of these terminations are not wanting in our pathological collections. Thus, in the Museum of St. Bartholomew's Hospital there is a beautiful specimen[2] of inflamed and thickened medullary membrane of the humerus, which shows, as a consequence of the inflammation, a portion of cancellous tissue exfoliated and lying loose in the medullary canal. A long fistula leads through the tube of the bone into the elbow-joint. The same museum possesses another specimen,[3] in which acute diffused suppuration, spreading through the tissues of many of the long bones, has caused abscess in the knees and ankles on both sides.

The symptoms of this grave affection are exceedingly obscure: it, like other extensive and acute affections of bones, is often accompanied by diffuse inflammation of the soft parts, which then masks the deeper affection. Rigors and general fever always mark the onset of acute osteo-myelitis, but the only known special symptom of the disease in the bone is the separation or recession of the periosteum from it, accompanying diffused pain in the bone, and not caused by effusion on the external surface of the latter. After amputations, a prominent fungous mass is often seen projecting from the end of the bone, and proves the existence of a certain extent of inflammation of the medullary tissue; but this need not necessarily have affected the bone so extensively as to deserve the name of osteo-myelitis; in fact, that affection is seldom recognized before death.[1]

To obviate the formidable dangers, and the extensive disintegration of parts connected with osteo-myelitis, it is justifiable in any case where pain in the bone, accompanied with the ordinary symptoms of acute suppuration (rigors, fever, etc.), but without signs of external or periosteal mischief, induces a reasonable suspicion of this affection, to expose the surface of the bone by a free incision. Should the periosteum be found separated, or even separating, from the bone, the diagnosis of diffused suppuration in the cancelli will be rendered highly probable. When this separation of the periosteum has proceeded to any great extent, amputation of the member, or excision of the diseased bone, is certainly indicated. It should be remembered that the disease is a rapid one, the fatal complications of internal phlebitis and pyæmia imminent; and therefore treatment, to be effectual, must be adopted early. Medicine, as might be expected, has little effect on the disease; but the fever which accompanies it should, of course, be treated on the ordinary principles. In deciding on the question of removing the diseased bone (an operation which would in ordinary cases be held to be contra-indicated if pyæmia had set in), it should not be forgotten how much the early symptoms of systemic infection resemble those of typhoid fever;[1] so that it may be proper in doubtful cases to give the patient the benefit of the doubt, and attempt to relieve him from the source of irritation.

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[1] Unless the infection of constitutional syphilis should be added. See infra, on Syphilis in Bone.

[2] Series i., No. 207.

[3] Ibid., No. 195. See also No. 104, a preparation in which the whole of the inner portion of the os calcis is separating from its outer wall, as a consequence of diffused suppuration through its cancelli.

[1] If after an amputation acute osteo-myelitis be suspected, the surgeon can establish his diagnosis by putting the patient under chloroform, and ascertaining by means of the probe that the whole medullary tissue is broken up for a considerable distance, as well as the small portion which is projecting out of the wound. See Fayrer, in Indian Annals of Med. Science, Oct., 1865. "The symptoms of acute osteo-myelitis are pain in the part, œdema, and swelling extending down the limb; general fever, with quick pulse, and increased temperature, and more especially the recession of the soft parts, including the periosteum, from the bone, which is then left denuded at the bottom of the wound."—St. George's Hospital Reports, vol. i., p. 156.

In chronic osteo-myelitis the removal of the limb is frequently successful in affording the patient relief from an abiding source of irritation, which will at length otherwise prove fatal; but when this affection is limited to a portion only of the bone, the expectant treatment is indicated, and the patient may recover after the extraction of a sequestrum.[2]

[Demarquay has a paper on Osteo-myelitis in the Archives Générales de Médecine, Sept., 1872, which is chiefly devoted to showing the close connection between this disease and pyæmia, and its allied conditions of systemic poisoning. Dr. H. Allen, Am. Journ. of Med. Sciences, Jan., 1865, shows from a careful study of a considerable number of cases that osteo-myelitis is not unfrequently the result of wounds where no bone has been injured, and also that this disease often exists when no symptom has announced its presence during life.

Dr. John A. Lidell, of New York, gives a very complete account of this disease, founded upon his large experience during the War of the Rebellion. After a sketch of the anatomy of bone, in which he emphasizes the fact that the common notion of an endosteal membrane corresponding to the periosteum is erroneous, and that the medulla is a homogeneous substance filling and in direct contact with the bone cavities, he goes on to divide the disease into two forms, the acute and the chronic. The acute is characterized by a sudden pain or aching in the bone, followed quickly by great constitutional disturbance, rapidly failing strength, and often death, within a few days, from asthenia. The causes of this formidable disease are, first, and most important, that peculiar combination of unfavorable circumstances which we call hospitalism, and which surely develops itself when large numbers of wounded men are crowded together. Secondly, this first great cause acts chiefly upon open wounds of bone, as compound fractures, amputations in continuity, etc. Concussion and contusion of bone may sometimes give rise to the affection when no open wound exists. The lodgment of a foreign body, particularly in the medullary cavity, syphilis, scrofula, and scurvy, all favor its occurrence, and the painful jolting and bruising which accompanies transportation is believed very often to light up the disease in injuries which might otherwise have escaped.

The symptoms of osteo-myelitis are:—

I. Pain, generally severe, accompanied by deep aching, which continues day and night, often with a feeling as if the bone were being broken or crushed. This pain is not relieved by incisions through the periosteum.

II. Local heat, which is not stated to attain any remarkable degree by the thermometer, and which is soon followed by

III. Swelling of the soft parts around the bone which is the seat of the disease. This swelling is a firm brawny-feeling œdema, which pits upon pressure, and often presents a well-defined and abrupt edge, which seems to mark the extent to which the bone inflammation has reached, and when well marked is considered a diagnostic sign of great value.

IV. Some redness is observed on the surface of the diseased region, though this sign is sometimes absent.

V. The pus becomes thin, acrid, sanious, and mixed with oil globules in abundance. If the discharge had become abundant before the disease commenced it is noticed that it rapidly diminishes in quantity and often ceases altogether. As the disease advances, the ill-conditioned discharge again becomes profuse, and has a fetid or putrid odor.

VI. If the opening into the medullary canal is visible, there can often be seen protruding from it a mushroom-shaped growth of granulations, which increase very rapidly and soon break down into a gangrenous detritus.

VII. The periosteum peels very easily from the neighboring bone-surfaces, and seems to be separated from them either by a layer of pus or of fibrinous exudation about to break down into pus. The diagnosis is not difficult when the injured bone can be easily inspected, but is often exceedingly obscure when the diseased part is concealed from view.

With the local signs above described, the general signs of constitutional irritation are early and strongly developed. Fever, rather of an asthenic type, with delirium, stupor, rapid failure of heart power, and utter prostration of muscular strength, sometimes hurry on to death within a few hours of the commencement of the disease, or instead of thus suddenly overwhelming the powers of life, they may be prolonged and merge into the more characteristic signs of pyæmia or septicæmia, with which the fatal cases are almost uniformly complicated.

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[1] See vol. i., p. 546.

[2] I would refer on the subject of chronic and acute osteo-myelitis, to the well-known paper by M. J. Roux, read before the Académie Imp. de Méd., and to the criticisms of M. Legouest, M. Larrey, and others on it, which are to found in the Society's Bulletin for 1859–60, vol. xxv.; to a paper by Mr. Longmore, in Med.-Chir. Trans., vol. xlviii.; and to one by myself, in St. George's Hospital Reports, vol. i., quoted above.

The pathological anatomy of osteo-myelitis presents three distinct stages, spoken of as carnification or hepatization, suppuration, and gangrene.

1st. The stage of carnification shows the marrow of a bone more deeply red than normal, and decidedly increased in the solidity of its feel. The increased color is due partly to a rapid formation of new marrow cells, which displace the fat, and partly to the increase in size of the vessels of the part which send a larger amount of blood into its tissue. From these dilated vessels we have the extravasations of blood which are often seen to stud the medulla as it were with a series of medullary apoplexies. The increased density is explained by the formation of fibrous tissue through the affected medulla, or perhaps also by the sclerosis of the intercellular substance. In some prolonged and less severe cases, a certain amount of bony deposit takes place, sometimes almost filling the medullary cavity.

2d. The stage of suppuration very much resembles the second stage of pneumonia. The red and indurated medulla becomes softened and of a yellowish color. This is due to the gradual transformation of the cells into pus, which at first infiltrates the tissues irregularly, then begins to collect into small purulent foci, which by their coalescence form abscesses. "These in their turn extend, and destroying more or less completely the medullary substance, fill the bone-cavities with pus, the pus now being found in direct contact with the denuded bone-tissue. This exposure is followed almost of necessity by a necrosis, the consequences of which are so serious that the original disease is sometimes lost sight of in view of the disasters which, perhaps, have followed at a considerable interval the earlier signs of osteo-myelitis.

3d. The last stage in the pathological changes in this disease is gangrene of the medulla. This is not a common termination of the affection, it belongs to the most acute and severe cases, and probably would be most often found in patients who have been already depressed by exposure to unfavorable hygienic surroundings. In these cases the marrow is found to have undergone a change of color from the red or yellow to a brownish black; the tissue is entirely broken down, and hangs from the openings in the form of shreds of putrid detritus. The whole medulla may rapidly give way to this fatal change, and of course we should have here a cause of necrosis more potent than mere suppuration, however extensive.

Osteo-myelitis sometimes terminates in recovery. Most recent writers, Pirogoff in particular, recognize this fact. It seems to be the less acute cases, and those which with a short acute stage merge into the sub-acute and chronic conditions which offer most chances of recovery. The severe and acute cases are almost uniformly fatal. It has already been stated that necrosis may be produced when destruction of medulla has largely occurred. This necrosis is of the kind which is termed central, involving the inner lamella of the bone looking toward the medullary cavity, and forming a tubular sequestrum which is imprisoned in the thickened and vascular bone-tissue which surrounds it. That this disease is sometimes the cause of these tubular sequestra cannot be questioned. That it is usually such a cause may I think be doubted. I feel quite sure that such tubular sequestra are commonly produced in a very different way, and are in the majority of instances entirely independent of precedent osteo-myelitis (see note in chapter on necrosis).

As a consequence of osteo-myelitis we may also have osteoporosis and caries, and in a certain number (about one in ten) the morbid action extends to the nearest joint, producing severe, often destructive arthritis. There seems to be also an unexplained tendency to thrombosis of the veins leading from the inflamed region. About 14 per cent. of the cases observed by Dr. Lidell showed this peculiarity more or less distinctly, and in about 35 per cent. of the whole number of cases pyæmia was developed. All the pyæmic cases died. Of all his cases, fifty-one in number, thirty proved fatal.

In speaking of treatment, Dr. Lidell very justly places the hygienic care of the patient in the foremost place. Everything that can be done to distribute wounded men, and to give them the purest possible atmosphere, tends directly to prevent the disease, and to increase the proportion of cures; with regard to medicinal treatment and topical management, nothing very new is advanced. In respect to operative treatment, free incisions down to the bone are advised in suitable cases, and where there is indication that matter is pent up in the medullary cavity trephining is recommended. Dr. Lidell recommends amputation in the sub-acute and chronic forms, as more likely to save life than when the operation is performed in acute cases. He brings evidence to show that amputation in continuity is a dangerous and uncertain procedure, and recommends that disarticulation should always have a preference over any section of the diseased bone, however localized the inflammation of the marrow may be supposed to be.

The association of this formidable disease with pyæmia is so frequent and so close that some have regarded them as identical. This erroneous view has doubtless been suggested by the fact that most of the fatal cases are accompanied by phlebitis of the neighboring veins, the larger trunks being involved as well as the smaller vessels in the immediate vicinity of the disease. This phlebitis partakes of the ill behavior of the bone inflammation, the veins being found distended with a plastic fibrin often putrid, or with an equal quantity of ill-conditioned pus. That this phlebitis is an essential feature of osteomyelitis has not been proved.]

Chronic abscess.—Limited suppuration, or abscess in the cancellous tissue, is an affection which is fortunately far more easily recognized, and far more under the control of surgery, than osteo-myelitis. It hardly needs to be said that this condition of bone was first discovered and described by Sir B. Brodie.[1] The symptoms are not always very clear, but a careful study of the case seldom fails to establish the correct diagnosis. The seat of the disease is almost always the articular extremity of the bones which form one of the great joints,—knee, ankle, or elbow. The tibia is more frequently affected than any other bone, and usually at its upper end. Chronic abscess may, however, occur in any situation.[2] The abscess is almost always situated on the superficial side of the bone, and is probably occasioned, in most cases, by external violence, or other causes, acting on that surface; but the history is often obscure, in consequence of the chronic nature and insidious progress of the malady. The disease is said to be more frequent in England than on the continent of Europe.[3]

The symptoms are, a dull aching pain in the part, often worse at night than during the day, liable also to other remissions and exacerbations, and increased by exercise or pressure. In most cases the bone is especially tender at one particular spot, where the abscess has advanced nearest to the surface, and there is slight tumefaction of the soft parts over it. Sometimes, but not always, a little enlargement of the bone itself may be made out. There is perhaps nothing very characteristic in these symptoms taken separately, or on a first examination; but the persistence of the whole assemblage of them for a considerable period of time, and in spite of judicious treatment, directed to subdue an inflamed condition of the bone, will be reasonable ground for the diagnosis of chronic abscess, and more especially if the neighboring joint be unaffected. The localized, and very circumscribed, tenderness is perhaps, when well marked, the most unmistakable symptom.

The condition of the diseased bone testifies very clearly to the nature of the morbid process, so that few museums are without some of these preparations. The following is Sir B. Brodie's description of the first preparation which he dissected:[1] "The lower end of the tibia is enlarged, and the surface presents marks of great vascularity. The bone in the preparation is divided longitudinally, and just above the articulating surface there is a cavity as large as a small chestnut. This cavity was filled with dark-colored pus. The inner surface of it is smooth. The bone immediately surrounding it is harder than natural."

If the case be allowed to proceed beyond this stage, serious and frequently fatal mischief may ensue from the extension of the abscess into the neighboring joint. Before this event occurs, however, the patient may be much inconvenienced by repeated attacks of swelling and pain in the joints when he attempts to use the limb, the effects of slight synovial inflammation set up by the neighboring abscess. Rest and cold applications will generally remove these symptoms, but only to recur as soon as the patient again attempts to move about. On the cure of the abscess they will immediately and permanently disappear. When the abscess has burst into the joint the affection of the bone becomes merged into the more serious injury to the articulation.

[The chronic disease thus described is perhaps the most common form of bone abscess, but a certain number of cases present some features entirely differing from those above described. These cases are at the onset acute, and suppuration takes place rapidly, with great local suffering and severe constitutional disturbance. The pus very soon perforates the compact tissue enclosing it, and is discharged on the surface, to the temporary relief, but not to the permanent improvement of the condition of the part. The opening not being free, and perhaps not direct, accumulations take place, provoking fresh inflammation, increasing suppurative activity, involving new portions of the cancellous structure, and opening at new points on the surface, and in this way a disease acute in its essential elements, by frequent repetition, leaves a condition of chronic disorganization which I have ventured to term "Chronic Sinuous Abscess." This disease, when it has existed for a long period and after many attacks of inflammation and suppuration, may cease to show any signs of active inflammation, and leave the part in a condition in which it is perforated by three, four, or more sinuses, generally all communicating with one another through a central cavity or chamber which marks the position of the original abscess. From these cavities is discharged a little thinnish pus varying somewhat in amount and appearance. In these cases it would seem as if active disease had ceased because the cancellous tissue was all used up in the morbid processes, or had become so much consolidated by frequent attacks as to be no longer prone to take on inflammatory action. In this condition the disease may last for years, the diseased bone becoming a purely local disorder, not influencing the general health, and not itself showing any disposition towards either extension or cure. The use of the limb may be measurably regained, and thus the patients are sometimes willing to endure, for an indefinite period, a complaint which only occasionally inflicts severe suffering upon them, and which their long experience with the disease has taught them to regard without apprehension. Two of my cases had lasted, one 15 and the other 16 years at the time of operation, a longevity which certainly argues badly for any hope of spontaneous cure. The reason of this unusual obstinacy is doubtless to be found in the indirect and therefore imperfect evacuation of the contents of the cavities, the sluggish character of the actions after the acute stage has subsided, and the unyielding character of the abscess walls, which permits no approximation of the granulating surfaces to one another. This local explanation of the intractability of these cases seems confirmed by the fact that there is usually no general condition on which they may be supposed to depend. The patients are mostly vigorous young persons in whom no syphilitic, strumous, or other constitutional vice can be detected, and in whom local actions would be likely to be healthful and reparative; and it is still further strengthened when we notice that, although the persevering use of internal remedies produces no appreciable good effect, yet the moment the local conditions are improved by appropriate operation, healthy repair begins and goes on rapidly to a sound and permanent cure. A single case will illustrate the disease sufficiently.

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[1] Lectures on Pathology and Surgery, ed. 1846, p. 395.

[2] In the Museum of St. Thomas's Hospital there are examples in the body of a rib, in the clavicle, and sternum. Series C., Nos. 84, 84^2, 85.

[3] Mr. A. Bruce, in Med. Times and Gazette, 1868, vol. i., p. 297.

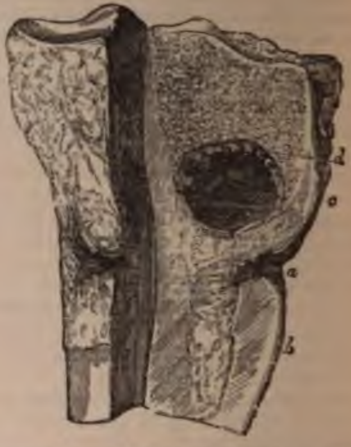
[1] Op. cit., p. 397. The original preparation is in the Museum of St. George's Hospital, series ii., 30.

G. B., æt. 19, entered the N. Y. Hospital in Nov., 1857, with a diseased condition of left tibia, dating about 14 months previously. He was recovering from what seemed a rheumatic attack, caused by exposure, when a sudden inflammation seized the lower part of his leg. He was confined to bed with great pain and high fever. An abscess formed in about three weeks, which broke on the anterior surface of the leg, about four inches above the ankle. The swelling and inflammation continued, and, during five months, he was scarcely able to leave his bed except on crutches. During this time, abscesses formed and broke at several points of the swollen limb, and at various times ten or twelve minute pieces of bone came away. For the last few months the acuter symptoms have subsided, and he has been able to go about, though with much discomfort. On examination the lower third of the tibia was enlarged to twice its natural size. Over it the tissues were thickened and brawny, and the skin presented several orifices of sinuses, which led down into the substance of the bone and discharged a moderate quantity of pus. The probe passed in at any of these openings goes deeply into the bone, and encounters some rough bony points, but no sequestrum. The ankle-joint is swollen and rigid for some months. His general condition excellent. No syphilis. An operation was performed by Dr. Van Buren soon after his admission, as, from the proximity of the disease to the ankle-joint, delay seemed dangerous. By the trephine and chisel the whole anterior wall of the cavity was removed and every sinus freely exposed. They were all found to communicate with a central cavity as large as a hickory-nut, which lay so near the ankle-joint that there appeared to be merely a thin shell of bone between it and the cavity of the joint. The sinuses which opened on the anterior surface of the bone were entirely exposed by removing their bony covering. Two sinuses, however, penetrated the bone so deeply and had their orifices so far back that they were left. All the cavities were lined by a smooth, soft, reddish, and very vascular membrane, composed of abundant firm granulation-substance, pretty fully organized. Through this membrane the bone tissue could be felt, but it was nowhere extensively exposed, and was apparently healthy. No sequestrum was found. The wound was lightly dressed from the bottom with lint. Everything went on favorably. Sound granulation began almost at once, and rapidly filled up the large chasm left by the operation. As healing progressed, it was noticed that the two sinuses which had penetrated the bone were also closed. His cure was rapid, and was complete when he left the hospital.]

Treatment.—In all cases, as soon as the diagnosis has been so far settled as to satisfy the surgeon that operative interference is justifiable, he ought to explain the nature of the case to the patient, and endeavor to obtain his consent to the simple operation which will at once establish the diagnosis and cure the disease. There is not generally much difficulty in obtaining the consent of the patient, whom long-continued suffering and enforced inactivity have rendered greedy of any chance of relief. Chloroform should be administered, and the suspected part of the bone well exposed by a crucial incision. The bone should then be perforated to a considerable depth with a small trephine, which should not have a shoulder. If one spot on the surface of the bone appears softer than another, this should be selected for the centre of the opening. Very often pus will be seen welling up in the groove, as soon as the trephine has penetrated the compact wall of the bone. The instrument may then be withdrawn, and on the circle of bone being raised with an elevator, the pus will be evacuated. The cavity exposed is lined with a thick "pyogenic" membrane, and its surface is very sensitive. The pus is only in small quantity (generally about a teaspoonful) ;[1] but its evacuation suffices at once to relieve the patient of his wearing pain, and he is soon restored to perfect health, the cavity being filled up with a fibrous material, by which in all probability the excised piece of bone is ultimately reproduced.

Two things may interfere with the complete and immediate success of this operation—the diagnosis may have been correct, but the place selected for trephining may have been not quite the right one; or the diagnosis may have been wrong, and the symptoms have depended merely on chronic ostitis. In the latter case, as may be seen by Sir B. Brodie's patient above referred to (p. 126, note), the operation will often do good, will relieve the pain of the inflammation, and perhaps prove the starting-point of a healthier action. It is well, however, remembering that this mistake has been committed by the best surgeons, to prepare the patient for it, so that he may not be too much disappointed if the surgeon shall afterwards have to confess that no pus was found. If, however, the trephine do not come down upon an abscess, it should not be forgotten that this may depend on the opening having been made on one side of the abscess, which may be lying close to the trephine-hole, but separated from it by a thin bony septum. This is illustrated by the accompanying drawing from a preparation in the Museum of St. George's Hospital. It is advisable, therefore, when the pus has been missed, before giving up the operation, to pierce the walls of the trephine-hole in several directions with a sharp-pointed instrument, in order to remove the bone freely with a chisel if a drop of pus follow any of these punctures.

574.



Unsuccessful trephining in chronic abscess of bone. *a.* The point where the trephine has been applied about half an inch from the abscess. *b.* The wall of the bone, thickened by inflammation. *c.* The cavity of the abscess. *d.* The pyogenic membrane. (From a preparation in St. George's Hospital Museum. Series ii., No. 31.)

Caries.—The word caries will be used in the sequel as equivalent to the term "ulceration of bone." It is true that some pathologists of the greatest authority have limited the use of the term caries to scrofulous ulceration, and others have sought to establish a generic difference between caries and ulceration. As to the latter point, however, I must confess that a careful perusal of works in which caries and ulceration are treated of under separate heads, has failed to make me see the distinction which the writers wished to establish; and with reference to the former, although there is as much difference between strumous ulceration and simple ulceration, when occurring in a bone, as there is between the same processes in soft parts, I cannot see that there is any more reason to attach a special name to the process as occurring in bones than in other tissues, while confusion is certainly occasioned by the use of a special term in many cases where the strumous nature of the process is only a matter of inference.

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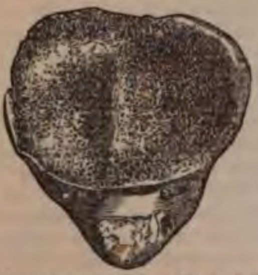
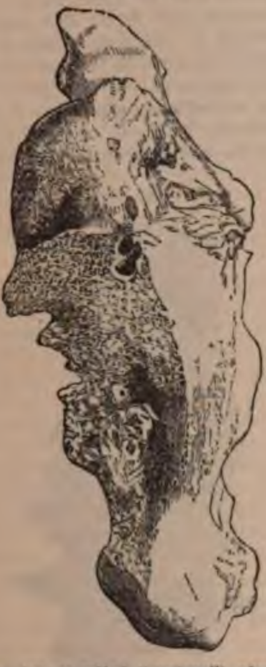
[1] In an abscess of the lower end of the tibia, after an old gunshot wound, lately under my care, there was at least half an ounce of pus. This was, I think, the largest cavity I have ever met with.

Fig. 575.



Simple ulceration of bone. (From a preparation (No. 607) in the Museum of the Royal College of Surgeons.)

Fig. 576.



Strumous (or so-called "carious") ulceration of bone. (Museum of Royal College of Surgeons. No. 625.)

[The view which regards caries as essentially an ulcerative process has given place of late years to that which regards it as primarily a chronic form of inflammation, with a tendency to infiltrated suppuration and to gradual destruction and removal of bone tissue. Billroth says: "Caries is actually only a chronic inflammation of the connective tissue of the bone with consumption of the latter;" and again, "Perhaps it would be better to gradually drop the name caries and replace it by osteitis, with varying additions, such as rarefying, osteoplastic, ulcerating, granular, etc." This view has been accepted by the principal German pathologists; and Rindfleisch has made a very careful study of the mode in which the destruction is carried on. He has proved that while the lime salts and the basis substance of the bone do at times seem to disappear simultaneously, yet, in a certain very large proportion of cases, the lime salts are first dissolved out, leaving the basis substance as it appears when bone has been soaked in acid; and that as a secondary process this basement substance itself begins to disappear. By the repetition of these destructive actions, large districts of bone disappear, leaving cavities which are spoken of as carious ulceration. It must be clear that this destructive action should be regarded not as the essential, but as an accidental feature of a process which may possibly exist for many weeks without any ulceration whatever. Virchow defines it as a degenerative osteitis; and Stanley, writing forty years ago, says: "I propose here to express by the term caries the changes which, under certain circumstances, are consequent on chronic suppuration in the cancellous texture of bone."]

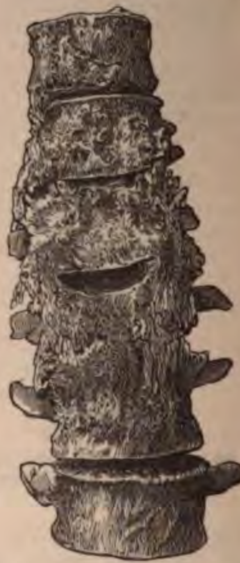
Superficial ulceration is distinguished by the following characters. The periosteum is loosened from the surface, and, if the disease is advanced, will be found much thickened, and converted into a villous mass of a pink color, resembling a layer of granulations. This substance adheres very loosely to the surface of the bone, and when lifted up from it, it is found to fit into depressions, which seem to have been hollowed out of the bone by the agency of the granulations. The bone at a very slight depth underneath is found, in most cases of healthy inflammation, of the ordinary consistence of cancellous tissue, which it resembles in structure even in those parts which ought to be compact. In strumous caries, on the contrary, the osseous structure will be found softened and otherwise altered, as will be described when treating of struma in bone; and it is to this combination of strumous inflammation of the body of a bone with ulceration of its surface, that the old descriptions of caries appear to be intended to apply. The ulcerated surface in healthy inflammation is superficially excavated, much softened, and easily broken down by the pressure of a probe. The interior of carious bone is softened by inflammation, its cancelli enlarged, and filled with the products of the softening and disintegration which have been going on around them. These products, as has been noticed above, are principally oil-globules, blood, and other débris of the soft tissues, and granular inorganic materials, having the same chemical composition as the salts of the bone. The soft tissues almost always take part in the morbid actions which lead to caries, and abscesses are formed which burst externally, and leave sinuses communicating more or less directly with the softened bone, and through which some part of its exposed surface can generally be felt with a probe. Abscesses, however, frequently form in the neighborhood of inflamed bones without any actual communication with them. This is, perhaps, more peculiarly the case in childhood, and near the joints.

Symptoms.—The symptoms of caries are merely those of inflammation *plus* an abscess exposing softened bone; hence all that has been said about the frequent obscurity of the early stages of osteitis will apply to caries, and with greater force, inasmuch as these ulcerative actions are more prone to occur in the course of low inflammations. Constant pain, then, in the neighborhood of a bone, with swelling and more or less loss of the function of the part, followed by abscess which will not heal, indicate usually that the abscess proceeds from ulceration of a bone; and this presumption is much strengthened if the pus have a putrefied, offensive odor, and a prominent mass of granulations project from the sinus; and it is converted into certainty if fragments of bone can be found in the discharge, or if the communication with the bone is sufficiently direct to allow of its being struck with a probe. When carious bone is touched by the probe, it is not usually found particularly sensitive, perhaps is not sensitive at all; it bleeds readily; its surface is irregular, and may generally be felt to be soft. When the opening is sinuous and the bone cannot therefore be struck, the diagnosis can be, of course, only inferential, and founded mainly on the persistence of the symptoms. Chemical analysis of the pus may also sometimes assist the diagnosis, since the pus from diseased bone contains more phosphate of lime than that from soft parts.[1] Sometimes the patient's sensations afford valuable evidence, more particularly in caries from healthy inflammation, where striking lightly over the carious part often causes the same kind of sharp pain as is felt when a carious tooth is struck.

Caries is generally accompanied by more or less of plastic or organizable effusion in the bone in the neighborhood of the ulcerated spot, leading to condensation of the deeper parts of the bone, and to periosteal deposit of bone on the surface. This, however, is the case only in those instances where the process partakes of the healthy or sthenic character. In those low inflammations which are usually called strumous, whether connected with obvious deposit of tubercle or not, such thickening or periosteal deposit is often absent; but the bone is softened throughout all the affected portion, the disintegration becoming less and less perceptible at a distance from the part where the loss of substance exists. The deposit around ulcerated bone frequently leads to anchylosis of the less movable joints; an occurrence which is extremely common in the tarsus.

[The bony deposits which take place at the periphery of the most actively diseased districts may be fairly taken to represent the attempt on the part of nature to repair at least some part of the mischief which has been going on at the diseased centre, and is, at the same time, so constant in its occurrence as to seem an essential feature in the carious process. The true conservative character of these deposits will appear when we reflect that it is precisely in those cases which make the most favorable progress toward a cure, that this osteo-plastic deposition solidifies and reproduces the parts which have been destroyed, and thus renders the damaged bone capable of fulfilling some at least of its original functions. Even those distant and peripheral formations, which seem to have so little connection with the central disease, are seen to have a conservative meaning, when from them arise

Fig. 577.



Caries of the vertebræ; the column supported by ossific deposits.

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[1] Bransby Cooper, Lectures on Surgery; Barwell, On Diseases of the Joints, p. 238, 1861.

those curious and beautiful bridges and buttresses of bone which spring from one diseased vertebra to another, spanning a chasm of carious destruction of two or three or more vertebræ, and sustaining the column in its tendency to forward displacement where no consolidation of the ulcerated bodies themselves could have afforded the needed firmness (fig. 577).

But while this osteo-plastic tendency is generally recognized as an essential and conservative part of carious disease, few writers have given much attention to those very peculiar and very characteristic granulations which invariably spring forth at the surfaces of osseous destruction and fill the cavities made by disease with a pale, flabby, fleshy mass which fills the morbid excavations, and often protrudes from the orifices of the fistulæ leading to the surface. Mr. Stanley fully recognizes these imperfect granulations, and seems to regard their formation as one of the regular stages of the disease. Billroth merely alludes to them as spongy granulations, to which he attributes the power of dissolving the bone tissue. May they not also be regarded as conservative in their type, and as representing a reparative disposition, though actual repair may be long and successfully opposed by obstinate and advancing disease?]

In cases of superficial ulceration of bone, the agents for its removal are either the periosteum, when that membrane remains entire, or the granulations which spring from inflamed surrounding parts when the periosteum has been removed.[1] Other cases, however, of ulceration are met with, in which the disease is more deeply seated, and commences in inflammation of the membrane lining the cancelli or medullary cavity, and where, therefore, the agents for the removal of the bone are to be sought in the vessels of this membrane. Such cases as these are very rare. I am able to refer to preparations showing the reality of the affection,[2] but I have no knowledge of the special symptoms which it presents, or the indications, if any, which it furnishes. It is evident that, shut up as the inflamed parts are in the interior of the bone, the products of inflammation can find no exit, and the disease must soon become merged in one involving more extensive destruction, *i. e.*, in diffused suppuration or internal necrosis.

A question is very frequently asked as to whether caries or ulceration in bone be a curable affection or not. To this only one answer can be given: viz., that no ulcerative, *i.e.*, destructive, process is ever curable, in the widest sense of that term, since some defect will always remain; but that ulceration in bone, like ulceration in soft parts, may terminate in cicatrization, or the reproduction of an inferior kind of bone which is less vascular, and less smooth and well formed than the portion which it replaces. This fortunate termination becomes less probable, the deeper the disintegration of the bone extends, and the more profound is the constitutional cachexia with which it is associated. In extensive strumous caries it is hopeless.

The *treatment* of bone affected with this form of inflammation is a matter of great importance; since upon the success or failure of such treatment, the preservation of the bone, and with it sometimes of the limb, or even of the life of the patient, may depend. Ulceration in bone does not differ materially from the same process in soft parts, except in the far greater length of time which it usually occupies. In the bone, as in soft parts, the powers of nature will in most cases suffice for cure, when cure is possible, if the parts be put in a suitable position, kept at rest, and preserved clean and free from the accumulation of the discharges.

[If the pathological view be correct which regards caries as a chronic inflammation, then the earliest stages of this inflammation must offer a most important opportunity for successful treatment. There are certain cases in which the early stages are marked by some degree of acuteness and activity. In these there is local pain and local heat, early swelling and early impairment of function. In these it is permissible to use local depletion, as by a few leeches, and their careful use is sometimes beneficial in allaying the starting pains which so often disturb the patient's sleep. This is exceptional practice, however, and it should always be remembered, when leeches are applied in such cases, that their too free or too frequent use tends to depress the vital energies of a part that has before it a long and uncertain reparative struggle. After local depletion the use of mercury has been much discussed, most observers agreeing that it has a controlling power in the earlier stages of the disease. Its use is advised after two methods, first as a purgative, and second, as an alterative. As a purgative, it operates very much as we see it do in certain cases of strumous ophthalmia, where a single dose will sometimes diminish inflammation, relieve the photophobia, and banish pain, which before was intolerable. So sometimes an occasional dose of calomel will act so kindly on the pain and soreness of a commencing caries that we cannot doubt its beneficial action. The alterative method of introducing mercury slowly and carefully into the system is believed by many good practical men to have more power in controlling the inflammatory actions in the earlier stages of this disease, and thereby at least limiting the future destructive tendencies of the disorder. In both modes of using mercury, great care should be taken against overaction of the drug, too free catharsis or any degree of salivation, both being inimical to vigorous repair. In some of the more chronic cases, the bichloride given in very small doses combined with some bitter tonic seems to exercise a favorable influence.

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[1] See Packard's Malgaigne, p. 106, for the appearances of a bone undergoing absorption by granulation for the removal of a sequestrum after compound fracture.

[2] St. Bartholomew's Hospital Museum, series I., No. 163.

During all the earlier stages of caries, rest of the affected parts is a prime indication. Most commonly the patient's own feelings induce him to seek rest, because exercise increases his sufferings. From the outset this rest should be insisted on by the surgeon. It should be perfect, constant, and generally will require to be maintained by mechanical arrangements. In this department modern surgery has been fertile. The first advance upon simple immobilization with the starch bandage, or the carved wooden splint, was made by the elastic extension with weight and pulley, especially applicable to the lower extremity, and requiring a long confinement to bed. From this as a beginning have sprung numerous ingenious instruments, which aim to give the necessary rest to the suffering part without confining the patient to bed, or seriously restricting the ordinary activities of the rest of his frame. All these apparatus have two objects in view: First, to immobilize the diseased joint, for caries is nearly always in their close vicinity; and second, to avoid the pressure of the diseased surfaces against one another, which pressure, though a normal stimulant to a healthy joint, is an injurious irritation to one that is diseased.

About these points, there is little difference of opinion; but a much more difficult question presents itself toward the close of those cases which show favorable tendencies, and where, if nothing be done to avoid it, an anchylosis more or less complete is sure to be established. Of course, in the cases that are recovering from extensive arthritic disorganization, all we can hope for and all we should aim at is a firm anchylosis, particularly in the lower extremity. But in all those very numerous cases where the disease has been moderate, the destruction of tissue limited, and the tendency to repair strongly marked, the question when to begin passive motion, and when active exercise may begin to be allowed, becomes a most important one. It is perhaps not possible to lay down rules by which we may be invariably guided in this important decision, but this has been my own experience:

First, I have waited till all abnormal heat and all local tenderness have disappeared, till dead fragments have ceased to be cast off, till the discharge is no longer offensive, and has assumed a healthy appearance, in short till all the signs indicated a confirmed local convalescence, and then I have felt that the time for motion of the part had arrived. In very slight cases, and particularly in children, a carefully guarded permission to use the limb is safe. But in the severer cases something more effective and at the same time more carefully ordered has to be done. Passive motion must be employed, at first by the surgeon's own hand; and it must be persevered in with no little courage, though it may at the moment inflict such serious suffering as to make it hard to believe that the manipulation is either safe or wise. A rule by which this passive motion may be regulated is one which was formulated by the late Dr. Alex. H. Stevens, viz., make as much passive motion at a fixed hour each day as you judge that the case will bear. If the pain and tenderness produced by the movements last more than twenty-four hours, then you have done too much. If, however, the effects have passed away by the same hour of the next day, then you may proceed and carefully increase the amount. No rule should be too blindly followed, but I have found this a good and a safe one in actual practice.]

But often the patient cannot wait for the completion of the natural process, and calls upon the surgeon to deliver him from the chronic malady which has become insupportable. Or, sometimes his health gives way under the protracted discharge; or, after an interval of quiescence, the caries again makes progress, and threatens to involve neighboring bones, and to impair the functions of the whole limb, if not arrested. This is more peculiarly the case in the tarsus, and other "irregular" bones. In the ordinary treatment, then, of caries, no other local measures are required than to provide a free exit for the discharges, and to keep the exposed surface of bone clean. The appropriate constitutional treatment will complete all that art can do to promote recovery, and more active surgical interference is not only useless but hurtful, as it risks doing harm without a reasonable prospect of doing much good. Incisions, however, should not be spared to the utmost extent necessary to keep the discharge free, or perhaps even somewhat beyond this limit. In fact, in all the acuter cases of osteitis, much benefit appears to follow the mere division of the tense structures over the bone. When the surface can be felt exposed and carious, it is still more necessary to have a free discharge; since otherwise, the pus, being confined, may burrow beneath the periosteum, and extend the mischief to the neighboring parts of the bone.[1]

Often after this free exposure of the carious bone, the disease will gradually subside; but when this is not the case, the question occurs, whether it will be proper to attempt to remove the carious surface and expose a more healthy one, either by rasping or gouging the bone, or by the application of the actual cautery; or to modify the diseased action by injections, or by applications to the carious part. The injections which are in use are composed either of iodine or dilute mineral acid. The latter is intended to unite with the base of the phosphatic salts of the bone, and thus to remove its surface by disintegrating successive portions of it. It has been tried, and is strongly recommended by M. Chassaignac;[2] and no objection appears to exist to its employment in suitable cases; but I cannot say that I have found much benefit from its use. The injection of tincture of iodine in the treatment of abscess depending on disease of inaccessible portions of bone (as in psoas and lumbar abscess), has been warmly extolled by M. Boinet.[3] But M. Robert, who has tested the practice by numerous trials, pronounces (what indeed theoretical reasoning would have led us to expect) that M. Boinet "has singularly over-estimated the good effects of iodine,"[4] and from the few trials that I have had the opportunity of making, I believe that M. Robert's estimate of this treatment is very near the truth. The iodine may be used diluted at first, with one or two parts of water; and afterwards the pure tincture (Lond. Phar.) may be used. It is better at first to withdraw as much of the injection as will run out, and cover the opening with a poultice. Numerous injections will be necessary.

In cases of superficial caries of bones which can be exposed without too much injury to the soft parts (of which the tibia and calcaneum are the most familiar examples), it may sometimes be advisable to rasp or gouge away the carious surface of the bone, and endeavor to arrest the further progress of the disease by the application of the actual cautery or strong nitric acid to the surface so exposed; or, if the disease be very superficial, the latter measure may be sufficient, without any preliminary removal of bone.

Mr. Pollock has employed the application to the carious surface of sulphuric acid, at first diluted with an equal bulk of water, and then more and more nearly pure, pencilled on the surface when exposed by turning away the soft parts. The first application dissolves a portion of the exposed bone, and chars and kills the rest of the surface; when this comes away, if more dead or diseased bone is exposed, it can be similarly treated, until a healthy granulating surface is reached. In this way also superficial exfoliations of necrosed bone can be removed. I have witnessed the success of this plan in the hands of my colleague, and can speak also favorably of it from my personal experience.

Another plan, which is applicable also to the treatment of caries in more deeply-seated bones, has been proposed by Dr. Fitzpatrick.[1] He converts the sinuses leading down on to a diseased bone, into a large funnel-shaped opening, by the repeated action of the Vienna paste (potassa cum calce), and having thus brought the diseased bone within reach, he pierces its tissue with a strong knife, trocar, or small trephine, and then freely cauterizes the full extent of the perforation. The cauterization is to be repeated till the whole extent of the disease seems to be removed, and the use of the limb is restored. Necrosis can, according to Dr. Fitzpatrick, be treated in the same way: "the caustic being very freely used, destroying all foul undermined integument, and leaving large clean circular openings, more than an inch in diameter, and extending deeply down into the sequestrum, into contact with which the caustic in stick and powder is to be freely brought." He recommends it also in simple inflammation (a recommendation in which I cannot say that I concur); but not in diffused suppuration. My personal experience of this treatment has been limited, and in one case which seemed peculiarly well suited for the treatment, and where the disease, which was seated in the ankle, was in a perfectly chronic state, the patient died of pyæmia.

These operations should, however, only be performed in cases of evident necessity. We have only too frequent instances of the dangers of all operations on bone, especially of such as involve the exposure of large surfaces of the cancellous tissue, as is generally the case in these gouging or rasping proceedings, which are extremely apt to be followed by diffused inflammation of the interior of the bone (osteo-myelitis) and by pyæmia. Still, if the disease be accompanied with much pain and loss of motion, and the wound show no tendency to heal, the patient is often compelled to have something done for his cure, as otherwise he would lose his means of livelihood; or the surgeon may think it right to interfere in order to arrest the progress of the disease into neighboring organs. The decision of such questions as these must, of course, be left to individual judgment.

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[1] Some authors teach that pus exercises a solvent power upon the bony tissue itself. This doctrine appears unsupported by direct evidence; and it seems improbable that the bone can be so dissolved while it retains its vitality.

[2] Mém. de la Société de Chirurgie, loc. cit.

[3] Ibid., vol. vii., p. 454.

[4] Robert, Conférences de Clinique chirurgicale, p. 208. Paris, 1860.

[1] See New Syd. Soc. Biennial Retrospect, 1867–8, p. 259.

The application of the actual or potential cautery appears to be less dangerous than cutting operations, and is often successful in superficial caries. It seems less in use than might be expected, considering the many cases of caries limited to one, and that a superficial, bone of the tarsus and metatarsus, which are seen, especially in children. Here, however, and in all situations where a bone can be removed without prejudice to the function of the part, excision is so much more satisfactory when any large part of the bone is involved, that it is, perhaps, not wonderful that the less radical measures are not much in use.

M. Sédillot has proposed a more extensive use of the operation of scooping or gouging carious bone, as a substitute for excision or amputation.[1] His plan contemplates the removal, by the gouge, of the whole bone except a shell of the outer healthy parts, which is left to effect the restoration of the bone. With all due respect for the authority of M. Sédillot, it seems impossible to allow that such a proposal is either useful or safe. There are few cases of extensive and deep-seated caries in which the limits of the disease can be ascertained, and a partial operation is often worse than none at all. Besides, extensive exposure of the interior of a bone is a most hazardous proceeding, and only too often terminates in pyæmia. M. Sédillot, however, is said to have performed his operation thirteen times without any instance of such complication. The further consideration of this question will occupy a portion of the essay on EXCISIONS.

Ulceration in bone is not always of this chronic nature. Mr. Stanley has described[2] some cases of "phagedænic ulceration" of bone which seem to have been connected with the occurrence of rodent or cancroid ulcer[1] in the soft parts; and in diseases more distinctly partaking of the nature of cancer the bones may be destroyed with great rapidity; but here the affection in the bones is only a part of the general disease, and its treatment must depend on the view which may be taken of the latter. Cases of rapidly spreading ulceration do, however, occur, in which the bone alone is affected.

[The peculiar disease which Mr. Stanley calls phagedænic ulceration of bone, and of which he gives in his brief paragraph a photographic picture, seems to have been regarded by him as a simple ulcer of a peculiar character. Of his three cases the features are all strongly suspicious of epithelioma. Unfortunately the history after amputation is not given. The following case, which was under my observation at the New York Hospital, completes the pathological history.

James O'Brien, æt. 32, was admitted Sept. 10, 1854, with an ulcer on the front of the tibia connected with enlargement and disease of the underlying bone. He had injured the part at the age of 12, and it had never perfectly healed. Sometimes it has almost closed, and then broken out again, gradually growing larger as years have passed, and occasionally bleeding quite freely. No bone has been discharged. The surface of the ulcer, half the size of the palm of the hand, irregular and prominent, was formed of large, hard, wart-like granulations, giving issue to a thin fetid pus. The probe, pressed among the granulations, entered half an inch into the substance of the softened bone. His general condition was good. Finding no improvement from treatment, Dr. Buck gouged the whole mass away, going with his chisel down to what seemed healthy bone. This was not followed by any improvement. No healing action occurred, but new granulations like those removed sprang up over the whole wound, and the ulcerating process was actually progressive and his general health rapidly failing, when amputation was performed just below the knee. The lower two-thirds of both bones were found greatly hypertrophied. At the seat of the ulcer there was a loss of substance equal to more than one-third the diameter of the tibia. The bone substance was irregularly excavated, and on the posterior surface gave evidence that the morbid action was extending through its whole thickness. The substance of the bone gave the idea microscopically that it was infiltrated with a material identical in nature with that of which the wart-like granulations were composed. The infiltration involved the skin, and, to some extent, the surrounding muscles. Dr. Jno. T. Metcalfe made the microscopical examination of the tumor, which was composed mainly of cells of various characters. Many were small, round, with well marked and sometimes double nuclei, others large, with branching processes, others spindle-shaped, but among them many large, flat, single nucleated cells, evidently epithelial.

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[1] Lancet, Dec. 10, 1859. Sédillot, Sur l'Évidement des Os.

[2] On Diseases of the Bones, p. 65.

[1] See vol. i., p. 375.

The man recovered well from the amputation, but about four months afterwards I saw him with large masses of new growth in the groin, which were breaking down into a sort of fungous ulceration, which was rapidly destroying the surface while the base was being as rapidly increased. True cancerous cachexia was daily deepening. I heard from him occasionally till his death, which took place a few weeks after I saw him. I heard that the autopsy showed large cancerous masses developed in the pelvis and in some of the internal organs, but could get no detailed report.]

Two remarkable instances have been put on record by Mr. Cæsar Hawkins;[1] in one of which the disease was only part of a general strumous affection, but peculiar on account of its extreme rapidity and great extent. The other was a very remarkable instance of removal, by disease, of great part of the skull-cap, and protrusion of the brain through the opening so left; but without the formation of pus. An abscess was found in the brain, but this was connected with violence done to the protruded portion of that organ, and not with the disease in the bones. No distinct proof of the presence of any constitutional cachexia was obtained, nor was the exciting cause of the complaint apparent. Its inflammatory nature was testified by distinct marks both of inflammatory thickening and of inflammatory erosion on the bone in the neighborhood. Therefore the old definition of ulceration as "absorption from inflammation" would strictly apply to this extraordinary case; and we have already seen (see pp. 119, 120) that the formation of pus, though an ordinary, is not an absolutely necessary, feature in ulceration of bone; but it is rarely indeed that so large a portion of bone is removed without the formation of abscess, especially when compact tissue is involved; for the instances of removal of inflamed bone without suppuration, hitherto noted, have occurred almost exclusively in thick cancellous bones, such as the vertebræ and tarsus.

Necrosis, or the death of some considerable portion of a bone, occurs as the consequence of any cause which sufficiently impedes the circulation in the neighborhood. This is precisely analogous to what takes place in the gangrene of soft parts; and as in gangrene the non-vascular parts are most easily affected, and then those which, though vascular, are furthest from the centre of the circulation, and in which the vessels are fewest and smallest, so the frequent occurrence of necrosis of bone is, no doubt, due to the comparatively small quantity of blood which circulates in that tissue, as well as to the inextensible nature of the osseous substance itself, in consequence of which any extravasation or product of inflammation causes pressure directly upon the bloodvessels, or narrowing of the channels for the conveyance of the nutritive plasma.

It is denied by some authors of reputation on this subject that necrosis is ever a consequence of inflammation of bone,[1] and they refer the disease always to periostitis or osteo-myelitis as its cause. But this appears an error in two senses. In the first place, there is no essential difference between periostitis, or osteo-myelitis, and inflammation of bone. The diseases so called are only inflammations in which the part of bone alone affected, or, as is much more common, the part *most* affected, is the external table or the medullary tissue. In the second place, the disease properly called osteitis very frequently induces necrosis, not indeed usually of the inflamed part, but of the parts in its neighborhood. The inflamed part itself does not usually perish, because the final cause of necrosis is the stoppage of the circulation by the obstruction or obliteration of the vascular channels, while the first effect of inflammation is the enlargement of those channels.

[That acute inflammation of bone does produce necrosis is acknowledged by most authors, Gerdy standing almost alone as a representative of the opposite opinion. The mode in which it acts is hardly clearly stated in the text. The inexpansibility of the walls of the Haversian canals will not permit the sudden increase which acute inflammation demands, and hence the corpuscles become crowded in the capillaries, so that first, retardation and afterwards stoppage of the current occurs; and as no relief can be received from the surrounding vessels in which the circulation is for the same mechanical reason and in the same way affected, it follows as a matter of course that the part most inflamed dies by reason of this stagnation of its circulation. This seems to be the explanation of those cases where after acute osteitis involving the whole thickness, and perhaps the whole shaft of the bone, the whole of the inflamed part falls rapidly into the condition of necrosis.]

When the osteitis has reached the stage of exudation, the dilated vascular channels become again narrowed; but the process takes place slowly, and organization, which involves the formation of new vessels, takes place in the exuded material as it is produced. Still, although the event is not a common one, traces of inflammation are seen on sequestra sufficiently often to show that the inflamed part does sometimes die. The same causes, in fact, which produce gangrene in soft parts will occasion the death of a bone; and among them inflammation holds a high place, less on account of its direct effect, *i. e.*, its tendency to produce the death of the part inflamed, than of its indirect consequences, whereby the circulation around the inflamed part is obstructed, and so necrosis of the neighboring parts is induced. Hence in the course of an extensive caries the circulation of some considerable portion of the bone is apt to be destroyed, and then a necrosis or loose piece is found in the middle of the ulcerated part. Such combination of necrosis with caries was called by the old writers dry caries or hard caries.

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[1] Med.-Chir. Trans., vol. xxxix., p. 285.

[1] Gerdy, Maladies des Organes du Mouvement, p. 217, 1855.

Another very frequent, if it be not the most common, cause of superficial necrosis is the denudation or separation of the periosteum, which occurs as a consequence either of direct injury or of effusion between it and the bone. It is true that large separations, and even extensive destruction of the periosteum may occur without the death of any portion of the bone, and this is indeed common in the bones of the head and face; but the peculiar circulation in the former, and the great vascularity of all parts in the latter region, sufficiently explain this fact. In other parts, it is the more general rule that when the periosteum is destroyed or separated over any considerable portion of a bone, the superficial layers of the latter will perish. This is one reason, among many, why it is important to adjust the soft parts over a bone denuded by violence, in order that they may rapidly adhere to it, and that so fresh vessels may connect the periosteum to the bone before the latter has undergone any irremediable change.

Violence, acting directly upon the bone, is another very frequent cause of necrosis, as is frequently seen in compound fracture, where both the periosteum and the medullary tissue are much damaged, and the bone dies without any proof of previous inflammation having existed. [It must not be overlooked that violence done to bone-tissue causes sometimes its acute inflammation, and from the incapacity of the tissue to undergo the changes induced by such inflammation portions of the injured tissue die.]

The action of cold is often exhibited on the bones as on the soft parts, and the subject will be found treated of under the head of Frost-Bite (Vol. I., p. 362.) In deep burns the bones are also occasionally charred, and they are frequently involved in gangrene of the superficial tissues, from whatever cause it arises. Certain caustic applications are well known as frequent causes of necrosis, of which the superficial exfoliation produced on the surface of the jaw, for the cure of epulis, is a familiar example. To this category belongs also the necrosis of the jaw which is produced by exposure to the fumes of phosphorus.[1] The various constitutional cachexiæ, especially syphilis and struma, are frequent causes of necrosis; but here the affection of the bones is only a variety of the inflammatory process.

The abuse, and even occasionally the moderate use, of mercury is another cause of necrosis. It is quite true that many of the preparations and cases entitled "necrosis from the abuse of mercury" may be explained as having been cases of syphilitic necrosis, in which mercury had merely failed to arrest the disease, and had nothing to do with causing it; but there are too many instances on record of the occurrence of necrosis of the jaw, during the administration of mercury for some disease which had no influence upon the bones, to admit of a doubt that the affection was directly induced by the so-called remedy. Thus, in the Museum of Guy's Hospital (No. 1091) is a sequestrum consisting of two-thirds of the alveolar process of the lower jaw, which is said to be "necrosis induced by the use of mercury for ovarian dropsy." Unfortunately it appears that what is a moderate use of mercury in one person, is equivalent in rare cases of idiosyncrasy to an excessive abuse, so that no practical rule can be laid down; but it is at any rate proper to remember this occasional effect of mercury, particularly when prescribing it for cachectic persons. In the Museum of St. Bartholomew's Hospital is a preparation, in which necrosis of the jaw is attributed to the administration of a few grains of mercury during a fever; but in some fevers necrosis has been frequently observed as a consequence of mere lowering, as it would seem, of the vital powers, without any mercurial cachexia.[2]

[One cause very potent in producing necrosis is long continued exposure to wet and cold, the two causes combined seeming to be more effective than either separately. Thus many cases are recorded when the disease followed long tramping through snow and slush, and where boys have remained long bathing in very cold water. These forms of exposure produce an acute osteitis which terminates in necrosis.]

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[1] This affection will be found treated of in the essay on SURGICAL DISEASES OF THE TEETH AND GUMS.

[2] See, in the Museum of St. George's Hospital, series ii., Nos. 91, 95, preparations in which both the jaw and the clavicle became necrosed in the same patient during the course of a fever.

It would be idle to attempt an enumeration of all the causes which may lead to the death of bone. The above are the most common, and will be found sufficient for practice. The symptoms and treatment are identical in most of these forms. Some will require special notice hereafter.

When a portion of bone is to die,[1] the first phenomenon is the cessation of circulation in it. This leaves it hard, white, and sonorous when struck. It does not bleed when exposed or cut into, and is insensible. Occasionally, when the dead bone is exposed to the air, and acted on by the presence of putrid pus, its color becomes nearly or quite black; large surfaces of hard, black, necrosed bone are sometimes left exposed by the sloughing of the skin over the tibia. The dead bone at first retains its connection to the bone around, as well as to the periosteum, or whatever part of the nutrient membrane may belong to it; but the presence of a dead part is never long tolerated by the living tissues, and accordingly the processes which are to eliminate it soon become perceptible on both these structures. The periosteum, or medullary membrane, as the case may be, separates from the dead bone and becomes inflamed, a quantity of ossific deposit (more or less, according to various circumstances) is poured out between it and the dead bone, and this deposit soon becomes converted into new bone, forming a sheath over the dead portion, by which the latter is enclosed, or *invaginated*, as the technical term is. The dead part is now called a *sequestrum*, a name only properly applied to it when loose and invaginated, though often incorrectly used of any piece of dead bone. While this sheath is being formed from the membrane coating the dead bone, changes are going on in the living bone to which it was attached. When the latter has been previously diseased (*i. e.*, when the necrosis has been of inflammatory origin), the inflammatory deposit which surrounds the sequestrum softens, pus is formed, and a groove of ulceration is produced at the expense of the circle of inflamed bone which forms the margin of the sequestrum. If the surrounding bone have been previously healthy, the sequestrum acts as an irritant upon it, setting up, first inflammation and thickening to a variable distance, and then ulceration. Thus a groove is traced around the sequestrum; and the formation of this groove is accompanied by suppuration, as has been described above (see p. 122). The pus formed in the neighborhood of the dead part makes its way to the nearest surface, and in so doing interrupts the formation of the periosteal sheath, leaving sinuses, or *cloacæ*, passing through this sheath from the sequestrum to the surface of the body, or sometimes into a neighboring joint or serous cavity. [The occurrence of cases in which suppuration does not occur in connection with necrosis are acknowledged to be rare. Cases, however, in which suppuration is long delayed and slight in quantity are not so infrequent, and these exceptional cases may lead to error, or at least uncertainty in the diagnosis, if due allowance be not given to their possible occurrence.] The presence of such sinuses, leading through the shell of bone to hard, smooth, sonorous bone at the bottom of the cavity, is the distinguishing mark of necrosis. Most of these points are illustrated by the accompanying figure. [See fig. 578, p. 144.]

The formation of the groove between the dead and living bone is a very slow process in the bones of the limbs, requiring generally many months for its completion. It is impossible to lay down any rule as to the time at which a sequestrum may be expected to be found separated from the rest of the bone. In animals, as has been proved by experiments,[1] the process may be completed in a few days. In children it seems to go on sometimes with great rapidity, especially in the bones of the face. On the other hand, instances are not wanting in which half a lifetime may have elapsed, and the process still remain unfinished.

One of these has furnished a preparation in the Museum of St. Bartholomew's Hospital.[2] It is the section of the shaft of a femur, exhibiting in its interior a small fistulous cavity, with necrosis of a small portion of the inner layers of its wall. A groove extends to some depth between the dead and the contiguous living bone. The limb was removed by amputation. The femur had been fractured thirty-five years previous to the amputation; the fracture was followed by abscess in the soft parts, and the formation of a fistulous passage leading to the interior of the bone, which passage remained open during the whole period from the fracture to the removal of the limb.

It may, however, be stated generally, that the more superficial the dead portion is, the more freely it is exposed, and the more violent the action of the cause has been, the more rapidly will it separate (see p. 127).

When the groove is completed, the dead

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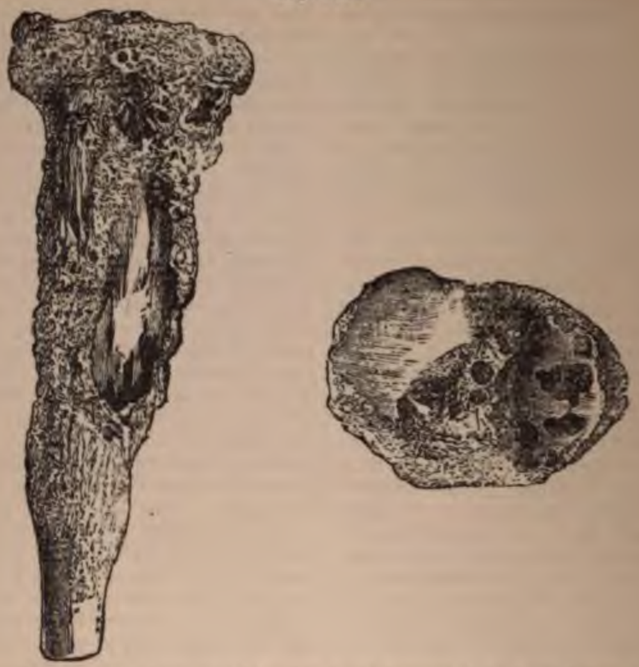
[1] This description refers to the process as it occurs in bone previously healthy.

[1] Troja, De novorum Ossium Regeneratione, exp. i.

[2] Series i., No. 176.

Fig. 578.



From a preparation (No. 3174) of necrosis of the tibia, in the Museum of the Royal College of Surgeons. To show the various points connected with necrosis of a portion of the shaft of a long bone—the sequestrum—its invaginating sheath, formed in a great measure by periosteal deposit, and terminating on the healthy surface of the bone, at some distance from the seat of disease, the openings, or cloacæ, through which the sequestrum is exposed, and (in this instance) the implication of the neighboring joint from the extension of these cloacæ into it.

bone is loose in the cavity so formed for it, and quite free from any vital connection to the body. [This is true in the dried bone, but not in the living patient. During life the surface looking towards the sequestrum is constituted by a layer of granulations, which, surrounding on all sides the dead piece, so support it that no space exists between the two and no motion can take place of the sequestrum in its cavity. In old cases these granulations become very hard and insensible, and form an admirable bed in which the rough and sometimes sharp-edged or sharp-pointed sequestrum often remains without doing harm for many months or even years. This bed of firm granulations explains the fact that the probe does not always detect mobility even long after the separation is complete. In order to elicit the fact that the sequestrum is loose, it is often necessary to press it with a strong steel probe down into the granulations beneath it so as to crush them, and thereby allow some displacement. By repeating this process somewhat forcibly we can soon get the sequestrum to move in its now enlarged enclosure, and appreciate the fact by the probe.] The sequestrum, therefore, is now eliminated, and this may be regarded as the natural process of cure, since it prevents the extension of the necrosis further into the bone; but as the sequestrum is still lodged in its cavity in the interior of the bone, it thus becomes an abiding source of life-long irritation, which must by all means be removed as speedily as possible.

The above is intended for a sketch of the process of necrosis in one of its most frequent seats, viz., the outer (subperiosteal) layers of the compact sheath of a long bone; but it may occur in any situation—in the medullary canal, or central layers of the compact tissue, in flat or irregular bones, or the spongy ends of long bones; or again, the extent of the necrosis, or the situation of the part, may modify considerably the process of separation, *i.e.*, the surgical aspect of the case. For example, even when necrosis is subperiosteal, and the process of separation normal, it may be in a part from which extraction is impossible, as on the inner surface of the skull, spine, pelvis, thorax, etc. The subperiosteal sheath is often wanting in the bones of the limbs when the soft parts have been extensively destroyed over the affected bone; and it is never formed in the skull, where necrosis is so common, nor in the cancellous bones, where, though less common, the disease is by no means rare. In such cases, when the dead bone is loosened from the living, it comes away of itself, or can be at once removed. Such a piece of dead bone, not confined by any invaginating sheath of new bone, is called an *exfoliation*. Again, it sometimes happens that the necrosed portion involves the whole thickness of the shaft of a long bone, and sometimes the whole length of its diaphysis; some instances even are exhibited in the museums where the epiphysis also has perished along with the entire shaft, though this is very rare.[1] Necrosis also sometimes attacks the epiphysis only, and even, as it seems, the deposit of bone which in early life forms the centre of ossification for the epiphysis.[2]

Each of these conditions is accompanied by noticeable peculiarities. When the whole thickness of the shaft is involved, especially in a bone, like the humerus, enjoying free and rapid motion, fracture is likely to follow on the completion of the groove, although this result may be obviated by the strength of the case of new bone. [This, however, is not common, the new bone being usually formed and consolidated before the separating process is complete. Some very interesting cases are recorded of fracture of the involucrum after it had been fully formed. These cases have sometimes been produced by very great and sometimes by very slight degrees of violence, according as the involucrum was strong or weak. The following is a typical instance:—

A. C., a strong and healthy butcher, had had necrosis of shaft of humerus for some years. A large sequestrum lay loose in its involucral cavity, but gave rise to so little inconvenience that he postponed the operation for its removal. On one occasion, in trying to lift a heavy piece of meat to hang it upon a high hook, he felt a sudden snap in his diseased arm, which fell helpless to his side. The bone had broken through the involucrum, and torn its way through the integuments, thus making a bad compound fracture. Between the fragments, in a large cavity, which was now quite exposed, could be seen and felt the sequestrum. This was his state when I saw him in consultation. The first thing to be done was to remove the piece of dead bone, which was easily accomplished, and we had then to deal with a compound fracture in which the ends of the fragments were composed of involucral instead of original bone tissue. The displacement was easily reduced, the broad broken surfaces of the involucrum fitting accurately into one another, and mutually supporting each other. The result was rapid and perfect. He has to-day, twenty-five years after the accident, an arm as strong and as useful as ever it was.]

When the whole diaphysis is involved, the case assumes a graver aspect, since the extent of inflammation which is necessary for the formation of the new shaft, and the great suppuration thereby produced, suspends, or perhaps permanently abolishes, the functions of the limb. The muscles become matted together, the skin œdematous and penetrated by numerous sinuses, the parts below incapable of extended motion or energetic action; cases even are on record where the inflammation, having reached the great vessels, has produced coagulation of the blood in both artery and vein, and consequent dry gangrene of the limb.[1] In other cases either the ulceration around a sequestrum, or other disease of the bone, involves a large vessel, or the point of an exfoliating portion of bone is driven into the artery in some movement of the limb;[2] and thus either a direct wound of the artery is produced (when the sinus of the diseased bone communicates with the laceration in the artery), or if no opening exists externally, a consecutive aneurism may possibly be established.

[Hemorrhages in necrosis are not uncommon, always important, often fatal. They occur sometimes while the patient is taking active exercise, sometimes when he is quiet in bed. They are sometimes slight, with no serious consequences, sometimes they are severe, profuse, and rapidly exhausting. Sometimes they cease spontaneously, sometimes they are uncontrollable by anything short of an operation. As to the slighter forms of hemorrhage, which commonly occur during active exercise, they doubtless depend upon the wounding of the granulations by the sharp edges or points of the sequestrum. Rest and elevation of the limb is all that is required to stop them. The severe cases have features most important to recognize. Thus we may have a sudden profuse gush of blood coming from several of the fistulous openings, with great force, and so rapidly that pallor and faintness are produced before the flow ceases. This may take place without warning, while the patient is asleep in bed. The hemorrhage generally ceases after this first outrush, but recurs again in the same sudden and unexplained manner until a fatal result, either immediate or by gradual sinking, terminates the case. That these cases constitute a formidable group will appear when I state that out of eleven cases which I have myself seen, six have died. These cases mostly occurred in the New York Hospital; in all the gravity of the condition was fully appreciated, and yet only five out of eleven were saved. This happened, too, when everything seemed to be doing well at the time the hemorrhage occurred, and in every case but one the opened vessel was accessible to ligature. The examination of these cases, either after death, amputation, or during operation, revealed the fact that in every one the artery eroded was the principal trunk, except in one instance, and in that case the vertebral was opened near its origin. Several other cases have come to my knowledge since these were tabulated, which raise the whole number to sixteen, bearing the same ratio of mortality, and showing the same pathological condition. The practical deductions from these facts are simple but momentous. The bleeding is from a main trunk, and will be fatal if let alone. The life depends upon promptness, and promptness can only grow out of conviction of danger. The danger is imminent, the remedy not doubtful. Two courses present themselves: either to tie the injured artery at the point wounded, or to amputate the limb. The real risk to the patient is that the surgeon, not fully alive to the real conditions, may wait too long, and not feel convinced of the necessity of operation until it is too late for the operation to save. If possible, the artery should be tied at the wounded point above and below the opening. If not possible to tie the artery at the seat of injury, amputation should be performed at once. A ligature on the trunk immediately above the injured point might prove successful; but it has the great disadvantage that it does not secure against distal hemorrhage, and in my judgment would be rarely successful.

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[1] Guy's Hospital Museum, No. 1160^{30}, necrosis of the condyles and shaft of the femur, and upper end of the tibia. See also No. 1160^{218}, referred to further on.

[2] See a case in my work On the Surgical Treatment of Children's Diseases, 2d edit., p 389. (Edward J. Eade.)

[1] Museum of St. Bartholomew's Hospital, series i., No. 134.

[2] Mr. Poland, in his essay "On Rupture of the Popliteal Artery," quotes one case of spontaneous hemorrhage from that vessel in necrosis of the femur (a patient of Dr. Porter, Dublin Journ., vol. v.), and two others where the artery was wounded by a sequestrum during active movements of the limb (Dr. Byron's case, Med.-Chir. Rev., vol. xxiv., p. 259; Dr. Jacob's Diss. Med.-Chir. de Aneurism. Edin., 1814). I have seen fatal hemorrhage from the lingual artery in disease of the jaw, and from the aorta in caries of the spine. Mr. Stanley (op. cit., p. 111) relates a case in which the capsule of the knee-joint was penetrated by the pointed end of the necrosed shaft of the femur.

Two cases may illustrate the two best modes of treating hemorrhage in necrosis:—

Case I. Martin Clancy, æt. 24, was brought to Bellevue Hospital, Oct. 29, 1869. He was pale and feeble, and said he had had several profuse bleedings from an ulcer in the thigh. These bleedings had occurred suddenly without obvious cause, and each had stopped spontaneously. He was wearing a tourniquet, put on by his outside surgeon. Examination showed necrosis of the shaft of the femur, of which he gave a clear history, dating back nearly seven years. Operation was urgently indicated, and Dr. A. B. Mott immediately performed it. The ordinary operation was first performed by removing the sequestrum through a liberal opening through the involucrum. This was easily accomplished, and a large, flat, sharp-edged sequestrum, evidently formed from the posterior compact substance of the femur just above the condyle, was removed, leaving a large cavity exposed, in which the next step was to search for the eroded artery. After a tedious and extremely difficult and careful search, the opening in the artery was found, from which, on loosening the tourniquet, the blood spurted freely. A ligature was applied above and below the opening, the two ligatures being about an inch apart. The wound was dressed lightly and partly open. Everything went on favorably, and the patient was discharged cured, Dec. 31st, about nine weeks after the operation.

The following case illustrates the second alternative which these cases present, viz., amputation:—

J. McKibbin, a lad of 14, had been under the observation of Dr. Gurdon Buck for several years, during which time the immediate care of the case was taken by Dr. W. W. Jones, of this city. He had had necrosis of the left femur dating back about four years. He had had at several periods slight hemorrhages of dark colored blood, which were easily checked by pressure, and doubtless came from the granulations lining the involucral cavity. He was doing tolerably well, when in August, 1855, after a long walk, he had a considerable bleeding, checked by moderate pressure, but returning again at intervals of several days. On the night of August 31st, while in bed, violent hemorrhage occurred, soaking the bed and cloths which were applied. On September 1st, on removing the bandages, arterial blood again rushed out with great force, requiring instant compression of the femoral above. Under these circumstances of instant peril, no hesitation was felt, and amputation was performed immediately below the trochanter. Examination of the limb showed a long, irregular and sharp-pointed sequestrum, partially extruded from its bed, through a large cloaca, and pressing on the side of the femoral artery, in which a large hole had been eroded by the contact. The opening in the vessel was plugged by a fibrinous coagulum, part of which seemed firm, as if formed some time before the final hemorrhages, and only partly displaced by them.

The specimen is now in the New York Hospital Museum. The boy made a rapid and perfect recovery.

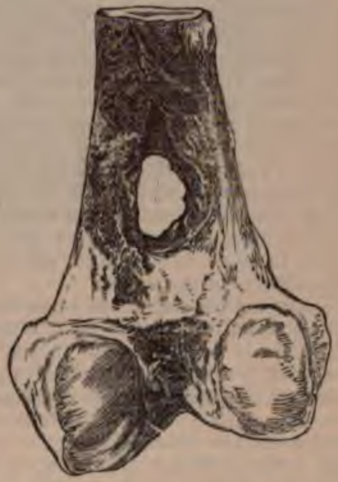
The explanation of these erosions of arteries is to be found in the fact that there is a disposition on the part of these sequestra to be extruded from their involucral imprisonment, and to seek the nearest surface, therein obeying a law which is common to all foreign bodies lodged in the organism. In consequence of this tendency to extrusion, we constantly see sequestra which are not tightly enclosed within a bony case finding their way to the surface, and easily removed. Even those sequestra which are enclosed within the involucrum are sometimes partially extruded through large cloacæ, and thus are brought within the reach of the artery which passes in close proximity. This happened in Dr. Buck's case, above related, and it is strikingly illustrated in a specimen we have in the College Museum. The specimen embraces the femur and tibia above and below the knee-joint, with the femoral and popliteal vessels. The femur shows an old condition of necrosis, with an involucrum, with large cloacæ, from one of which protrudes the end of a sharp and ragged sequestrum, which, emerging in the popliteal space, has caused a large erosion in the popliteal artery. It was taken from the body of a member of our profession, who had several sudden hemorrhages, and before the extreme remedy of amputation was decided on was so reduced that amputation came too late to save his life.

The same pathological view explains the occurrence of some of the most formidable of these hemorrhages when the patient is perfectly quiet, perhaps asleep in bed. The sharp edge of the sequestrum is gradually approaching the artery, by virtue of a force which slowly but steadily brings them together, entirely besides and independent of any muscular movement which may drive them into contact.

Fig. 579 represents the lower end of a femur amputated for hemorrhage from the popliteal artery, which had been opened by a sharp sequestrum from the posterior surface of the bone. The specimen is remarkable from the perforation which has taken place, due to the actions which were going on in the bed from which the sequestrum was obtained. This specimen is in the New York Hospital Museum.]

In any case of such injury to the main vessels, when the diagnosis can be properly established, amputation would be indicated, in the lower limb. In the upper limb the main arteries are separated from the bone by a mass of soft parts; and smaller vessels would hardly complicate the case, as they might be included in the incisions required to expose the diseased bone. In other situations attempts must be made to tie the ulcerated vessel; and if they fail, as they generally will, from the rotten condition of the parts, the trunk leading to it must be secured by ligature or acupressure.

[Fig. 579.



Perforation by a sequestrum. (Specimen in the New York Hospital Museum.)]

In cases of necrosis involving the whole thickness of a bone (*total* necrosis), when the seat of the disease is a large bone, such as the femur, life is in considerable danger; and as the patients are usually persons in whom some constitutional cachexia is present, and probably in an advanced stage, they frequently succumb.[1] Still the dangers of amputation in these cases are so great, and the advantages of saving the limb so decided, that they are usually left to the reparative powers of nature. In small bones, such as the phalanges, amputation is indicated. In the upper limb large portions of the whole thickness of the shaft may be removed with entire success, and preservation of the motions of the extremity. In the essay on EXCISION, the indications for excision of the whole or parts of bones on account of necrosis, involving their whole thickness, will be further considered.

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[1] An interesting case of total necrosis of the shaft and upper part of the femur in a young subject, aged thirteen, in whom amputation was successfully performed a year and a half after the commencement of the disease, is recorded by Mr. Kerr, of Aberdeen, in the Ed. Med. and Surg. Journ., 1834, vol. xlii., p. 98. It is worth perusing, as showing the activity of repair at that early age.

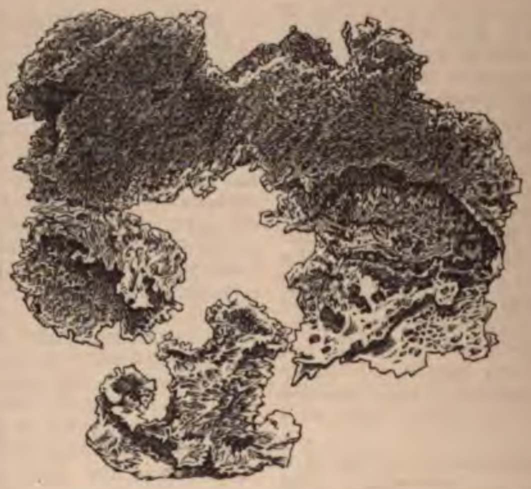
Central necrosis is usually an obscure complaint, and is hardly distinguishable by its symptoms from chronic abscess of the bone. In fact, as their symptoms are the same, so the same treatment is applicable to each of them. Deep-seated pain, throbbing, loss of rest, general debility, perhaps rigors and some amount of fever, with slight puffiness over the seat of the disease, and a little pain on pressure; these symptoms persisting for a considerable period without relief, notwithstanding that the appropriate constitutional and local remedies have been employed, indicate the necessity of making an exploratory incision at the seat of the inflammation, and, if the surface be found healthy, of removing it with the trephine in order to search for an abscess or sequestrum in the centre.

Deep-seated necrosis often leads to suppuration, making its way to a free surface. This is very common in the long bones, and is a frequent cause of abscess and destructive inflammation of the joints. Necrosis may also attack a portion of the articular surface of one of the great joints of the body, although this is rare except as a complication of extensive strumous affection of the joint-surface. Limited necrosis of articular ends is, however, occasionally met with, and, like the previous affection, will set up abscess in the joint. The diagnosis of these causes of articular abscess must be sought in the essay on DISEASES OF THE JOINTS, and the indications for operative treatment in that on EXCISION.

In the flat bones, where they are formed of compact tissue, necrosis is an exceedingly common disease; but here, as has been before observed, the dead bone will usually exfoliate without invagination.

[It should be noted here, however, that although no invagination takes place in these cases of necrosis of the cranial bones, the process of exfoliation is an extremely uncertain one. In fact in many cases of long standing and extensive necrosis of the cranium, no effort at separation can be observed, even when the disease has existed for years. These cases, I believe, are most commonly syphilitic, and in one case of this kind, on which I had occasion to operate, a dead portion of the os frontis was known to have been so for three years, and yet the chisel and the rongeur revealed no point at which separation had even commenced. This peculiarity of non-separation is also sometimes seen in necrosis of the lower jaw, where often the process of separating the dead from the living parts is unwillingly undertaken, and slowly and imperfectly performed. This feature is not always observed, exfoliation sometimes taking place promptly and completely. This I have seen in several traumatic cases, and in one case of syphilitic necrosis of the cranium, under the care of Dr. F. H. Hamilton, at Bellevue Hospital, one large sequestrum came away with ease as if already separated (Fig. 580). This was the more noticeable, because at most other points no evidence of separation could be discovered.

Fig. 580.

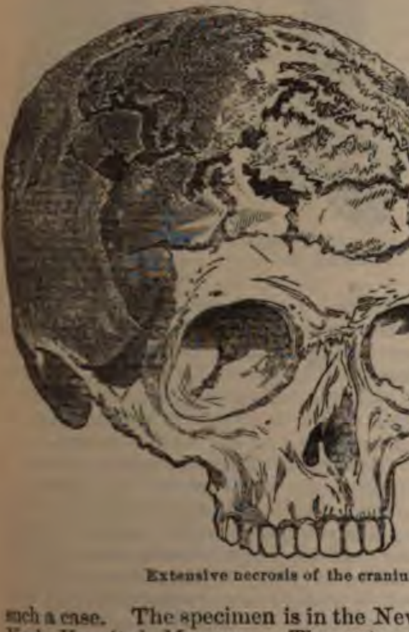


Large sequestrum from a case of syphilitic necrosis of the cranium.

Another feature of this disease, as it attacks the cranium, is a disposition to spread gradually and slowly over large districts of the skull. This progress is usually characterized by puffy swellings of the scalp, which slowly suppurate, and then ulcerate, destroying the entire thickness of the scalp. At the bottom of these ulcers, the bone is found to be bare and dead. This disease makes progress in two ways. 1st. By new puffy spots followed by ulceration disclosing dead bone, and 2d, by an extension of the necrosis itself, sometimes undermining the edges of the ulcer, and sometimes enlarging its area. This gradual extension of the necrotic action is almost peculiar to the flat bones of the skull. The death seems to be preceded by a thickening and roughening of the surface about to die, evidently due to a hyperæmic action in the bone-substance, but which makes no considerable advance as an active process, being so promptly followed by the death of the part involved, that the necrosis seems to advance by its own infective action rather than to be preceded by a vital bone change, which careful inspection, however, shows to have preceded actual death.

By this progress of steadily advancing necrosis, large districts of the skull are invaded, some times involving nearly the whole calvarium. Fig. 581 represents such a case. The specimen is in the New York Hospital Museum. The rate of progress of this form of necrosis is usually slow, several of the recorded cases having occupied years in their course. The depth of the destructive action varies very much at different points, in some involving only the outer table, and in some destroying the whole thickness of the bone. Some ulcerative or carious action is unquestionably set up in the course of the disease, for we find erosions and perforations of the bone at various points which can in no other way be accounted for. The dura mater opposite those points of bone entirely necrosed is thickened, sometimes granulating, and separated from the dead-bone surface by a layer of pus. This purulent collection commonly communicates with the external surface by means of the carious openings above referred to. The termination of several of the recorded cases has been by meningitis.

Fig. 581.



Extensive necrosis of the cranium.

The removal in these cases of the dead bone has usually given an imperfect result. Either it has been found impossible to remove all the dead portion, or after complete removal the disease has recommenced in the neighboring bone, and steadily advanced to a fatal termination. I do not believe that any remedies now known have any direct effect in arresting its progress.]

The same may be said of the necrosed portions of irregular bones, which consist almost entirely of cancellous tissue (such as those of the tarsus), in which necrosis is by no means rare. Whole bones, or large portions of entire bones, of the tarsus, and sometimes, but less often, of the carpus, are found quite separate from all their attachments, and merely retained as foreign bodies among the soft parts. In such cases there is sometimes a little difficulty in making the diagnosis; since the dead bone has not the hard ringing sensation usual in necrosis of compact tissue, and the large size of the necrosed piece sometimes prevents it from moving under the probe. The case, therefore, simulates one of caries.

> This difficulty was experienced in the case of a little child under the writer's care, in whom a sinus existed leading down upon the os calcis. The probe passed down to soft bone, not in the least movable, and crumbly to the touch. On the soft parts, however, being turned back, it was found that the posterior part of the calcaneum, involving at least half the bone, was dead and quite separated from the anterior part. This having been removed, the child made a rapid recovery. I have seen similar cases in childhood repeatedly, and more especially about the tarsus.

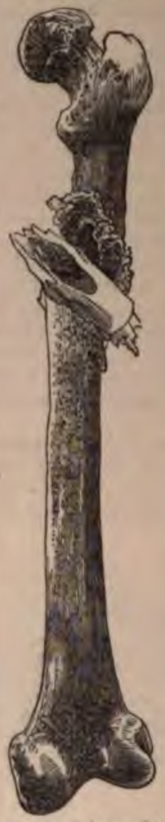
However, though the cancellous tissue is sometimes affected with necrosis, it should be remembered that this is exceptional, and that necrosis is an affection more peculiarly of the compact tissue, and especially of the densest bones. Thus the petrous bone is frequently necrosed, and has been known to exfoliate almost entire.[1]

[I have seen one of these petrosal sequestra which was removed by Dr. C. R. Agnew from a patient who had been long suffering with suppurative otitis media. His report of the case says: "It will be observed that the sequestrum includes the wreck of the labyrinth. The cochlea is seen laid open by caries, and two of the semicircular canals are seen in part. The vestibule is bereft of its furniture, and almost obliterated. After the operation the patient rapidly regained his health, and by the end of the year the external meatus had become closed by cicatrization."

Necrosis occurring after compound fracture is worthy of a moment's notice. The death of a portion of the ends of one or both fragments after compound fracture depends either upon the exposure of the injured bone to the air and the decomposing fluids of the wound, or to separation of a fragment from all its vital connections, so that it dies from want of nutrient supply. Practically perhaps this distinction is not of great importance, for the main fact we have to deal with is the presence of dead bone in the wound. This ordinarily does not declare itself in the early stages of the case, and it is only after the process of repair is far advanced, that we begin to find its completion hindered by the presence of a foreign body, which delays and will prevent final healing. This the probe easily discovers to be dead bone, and the chief clinical interest in the case lies in determining the proper time for its removal. Union is not by any means always prevented by these sequestra between the fragments, but, in many cases, it is weak and imperfect while the sequestrum remains, and becomes solid only when the offending body is removed. Fig. 582 shows a case in which a large original fragment which had become jammed between the ends of a broken femur almost entirely hindered union, the actions of repair being represented by some slender bridges of bone thrown out around the intruder. Fig. 583 shows secondary death of the extremities of both bones after compound fracture of the leg.

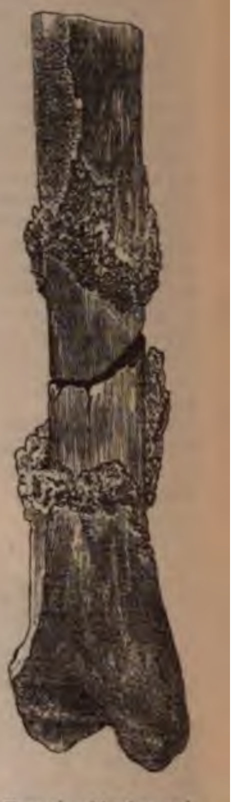
In the treatment of these cases boldness and thoroughness are the soundest surgery. A liberal incision should be made at the seat of fracture and enough of the callus cut away to expose the dead fragments and permit their complete removal. Of course care should be taken not to sacrifice any of the bond of union unnecessarily, but the removal must be complete or the wound will not heal. There is less reason to hesitate about these operations, because it is found that the new traumatism generally sets up new reparative activity, and therefore even in cases where the operation has been done without finding a sequestrum, a new impetus has been given to the process of repair, which was before sluggish and ineffectual, and under this new stimulus union has taken place and the wound healed.]

Fig. 582.



Necrosed fragment hindering union.

Fig. 583.



Necrosis of broken ends of tibia.

Treatment.—Hitherto we have been considering the usual method of separation; and as this is a long and tedious process, seldom completed under many months in the case of a large sequestrum, and often dating by years, it is not surprising that efforts should have been constantly made to anticipate the period of cure by cutting away the diseased bone. These, however, have hitherto resulted in disappointment. The process must be left to find its natural completion in the spontaneous separation of the dead bone from the living; and any attempt to effect this by operation, *i. e.*, to detach the necrosed portion, and to cut it away from the living parts, only extends the area of the disease, and endangers the preservation of the limb. Special considerations, applicable to some regions of the body, such as the skull, may indeed induce a surgeon to operate on necrosed bone before it is loose, for the relief of matter pent up below it: such operations, however, are not undertaken with a view of curing the diseased bone, but of restoring the function of organs secondarily affected. Such has been the result of surgical experience up to the present time. I have, however, pointed out above (p. 139), that a sequestrum of limited extent may be dissolved out by the action of sulphuric acid, or probably of potassa fusa, and thus the slow process of vital action necessary for its separation may be anticipated. In order to obtain success, however, in these proceedings, it is essential to know exactly the limits of the disease.

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[1] Path. Soc. Trans., vol. vii., p. 335. A similar case occurred at St. George's Hospital, under Mr. Prescott Hewett's care; Museum, St. George's Hospital, series ii., 99.

But when the sequestrum has separated and lies loose and invaginated in new bone, surgical interference is most necessary. There is perhaps no part of surgery in which the improvements effected in comparatively modern times have done so much to preserve life and limb, and to obviate pain, as in the treatment of necrosis. The invaginated portion of bone can never get out by any natural process: the very completeness and efficacy of the efforts which nature makes to preserve the continuity of the bone, and to restore its strength, effectually imprison the dead portion. Small pieces or granules of dead bone constantly exfoliate from carious surfaces; but when the sequestrum is of any considerable size, the cloacæ are never so large as to admit of the escape of the sequestrum through them, although sometimes they are very nearly large enough. Thus, in the Museum of St. Bartholomew's Hospital, there is a curious specimen,[1] in which a small piece of loose bone, just too large to get out of any of the numerous cloacæ which have formed around it, is found rattling about in its cavity as if in a dice-box.

The requisite operation consists in cutting down on the dead bone, and exposing it sufficiently to remove it. If the necrosis be superficial, nothing is required beyond turning back the soft parts, which have no connection with the dead bone, elevating the latter, and pulling it out with a pair of forceps. But, for the removal of an invaginated sequestrum, it is necessary to open the sheath by enlarging one of the cloacæ with the trephine, or cutting forceps, until it is large enough to admit of the extraction of the piece. Sometimes, when the sequestrum involves a large portion of the shaft of the bone, it may be found impossible to get the piece away until a pair of cutting forceps or a trephine has been introduced through the enlarged aperture, and the dead bone divided. In the necrosis which so often attacks stumps after amputation, a ring-like piece may separate from the end of the divided bone. Its extraction is then a matter of considerable difficulty; but still, as there is a free opening on to the extremity of the dead bone, it may be accomplished with some little trouble. If a similar sequestrum should form on one of the long bones, involving a ferrule-like portion of its surface, its removal would be still more troublesome, requiring free incisions on both sides of the limb: but I am not aware that such cases have been noticed in practice.

[Necrosis not unfrequently occurs in the sawn extremity of a bone after amputation. Commonly this necrosis is limited to a small ring of bone at the end, which may be supposed to have been injured by the violence of the saw, or which, by exposure to air and the decomposing fluids of the wound, has lost its vitality. These cases give rise to very little trouble, beyond keeping the wound from final healing, and are usually soon detached and easily removed.

There is another form of necrosis in stumps not so fully described, and, I think, often misunderstood. The clinical history of a case of this kind is about as follows: A healthy man undergoes amputation through the middle of the thigh for injury. He recovers well from the operation, the wound heals rapidly and well, and progress is satisfactory in every respect, until at the end of a month or six weeks, the stump, which should be soundly healed, shows still one or two fistulous orifices, from which a moderate amount of healthy pus is daily discharged, and which refuse to close. The stump is tender, and the patient suffers some pain in it, particularly when he attempts to leave his bed and go about. On feeling the stump it is large, full, firm to the touch, tender, and hot. On pressing deeply, the enlargement is found to be due to the increased size of the bone, which can now be perceived to be the chief seat of pain and tenderness. While this lasts the patient's general condition does not frankly improve, as might be hoped, and there is evidently something keeping him back from satisfactory convalescence. If now a probe be introduced into one of the openings bare and dead bone is immediately encountered. The pathological conditions accompanying this history are found to be a necrosis occupying the central part of the bone stump, extending from three to six, or even eight inches upwards, towards the trochanter. The dead part is found to be of a tubular shape, and corresponds with the inner lamella of the sawn bone, which inner layer of the bone has, for some cause or other, fallen into necrosis. The outer laminæ of the bone have become greatly thickened, and osteoporotic, and surround the dead lamella as any ordinary sequestrum is surrounded by its involucrum. This enlargement of the living bone, with the thickening of the periosteum, which is very great, explains the deep tumefaction, which was felt on handling the stump before dissection. The medulla is found within the tubular sequestrum, scarcely affected by the actions around it. The sequestrum is thus enclosed between two laminæ, which both have the bone-generating power, so that if the dead piece remain long enough *in situ*, it is engaged between two layers of bone, the outer being the involucral external lamina of the femur, the inner being the ossified medulla. Loose in its bed between these two lies the sequestrum, and if the stump be opened, and the projecting end be seized with the forceps, the foreign body can easily be drawn out.

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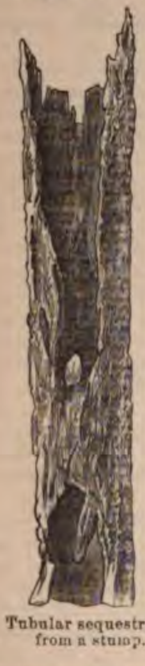
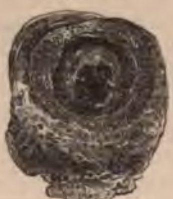
[1] Sub-series A, No. 94.

Fig. 584.



Tubular sequestrum from a stump.

Fig. 585.



End-view of the same bone.

It occasionally happens, however, that there are some openings in the sequestrum, through which osseous bridges shoot across from the outer to the inner involucral layer, and thus imprison a sequestrum, which is otherwise entirely loose, and could, but for this obstruction, be easily removed. Figs. 584 and 585 are representations of a sequestrum which was thus imprisoned, and which required an extensive operation to set it free. In the New York Hospital Museum we have quite a number of these tubular sequestra, varying in length from three to seven inches.

In explaining the occurrence of these peculiar sequestra writers have usually invoked the agency of osteo-myelitis in some form, which, it is believed, by depriving the inner lamina of nutrient fluid, and, perhaps, poisoning its tissue by foul and decomposing inflammatory secretions, has produced its death. That inflammation and suppuration of the medulla may and do sometimes produce more or less extensive necrosis cannot be denied; but such inflammation is a distinct and formidable disease, with serious constitutional as well as local symptoms. How then explain the occurrence of these sequestra when no such disease has affected the stump, and when, on the contrary, the whole progress of the case has been, perhaps, exceptionally favorable?

An explanation which covers all these cases is found in the relation of the nutrient artery to the medullary blood-supply. The medulla receives its chief supply from the main nutrient artery, which usually enters the bone by a single large foramen, and then divides into two sets of branches, one set for the medulla itself, and another which supplies the inner lamina of the bone, which looks toward the medullary cavity; the outer lamina of bone being nourished by vessels coming from the periosteum. This nutrient artery, in passing toward the foramen of entrance, has, in some bones, an upward course, so that a part of its career is outside of and below the nutrient foramen. If now, in making the incisions in amputating, this artery be cut below its point of entrance into the nutrient canal, then the inner lamina of the stump bone will be entirely deprived for the moment of its arterial supply. In soft tissues this temporary deficiency would immediately be obviated by the enlargement of the anastomosing vessels, which would promptly bring a sufficient supply to maintain life, and finally restore the equilibrium. In the bone, however, with its whole vascular system enclosed in rigid and unyielding bony canals, this secondary supply may come too slowly to save the lamina, deprived entirely of its arterial supply, from immediate death. The medulla itself will not perish, for its anastomotic supply is easy and abundant, and the external lamina is, of course, not affected by the calamity which has befallen the inner one. From all this comes the fact, which careful post-mortem study demonstrates, that the dead lamella is enclosed between two living walls, the outermost being the original bone, and the innermost being the surface of the medulla, which, after a time, becomes the seat of osseous deposit, forming the inner tube of enclosure, thus causing the section of such a bone to give three concentric circles, the outer one being the original outer lamella, the inner circle being the ossified surface of the medulla, and between them a ring composed of a section of the tubular sequestrum of the inner lamella, which has perished as above described.

This anatomical arrangement of the three laminæ, two living and one dead, is well shown in fig. 585, which represents the sawed end of a femur stump, some months after the removal of one of these tubular sequestra. The stump had re-ulcerated in consequence of a fall, and it became necessary to saw off an inch and a half of the end of the bone. Of course the dark middle space indicates the cavity from which the sequestrum had been removed, and not the sequestrum itself.

The explanation of this necrosis, given above, becomes more probable when we remember that, in a very large proportion of femora, the nutrient artery runs upwards, and enters the bone at a point about the middle, or just above the middle of its shaft. In the humerus the nutrient artery enters the bone above its middle, and its course is from above downwards, saving it from the possibility of being cut off before it enters the canal, as must so often happen in the femur. I have never seen one of these sequestra in the humerus, and I know of no case in the tibia, where also the course of the nutrient artery is from above downwards. Such an accident might be possible in the radius or the ulna, where the direction of the artery is from below upwards.]

A preparation in the Museum of St. George's Hospital (series ii., 75) shows a strip of necrosed bone winding spirally, for a considerable distance, round the shaft of the humerus.

It has sometimes been made a question whether the sequestra of necrosed bone can be removed by a gradual process of disorganization and molecular decay. If this question be proposed as an essay in scientific pathology, there is no doubt of its great interest; but viewed as a practical consideration in surgery, hardly any value attaches to it. Experiments on animals certainly appear to show the possibility of the removal of small pieces of excised bone re-implanted in the excision-wound;[1] and it is possible that, in the human subject, sequestra of bone may be to some extent eaten away by a process of absorption like that which sometimes removes the ivory pegs driven into bones for the cure of ununited fracture (see Vol. I., p. 509);[2] but even allowing all upon this head which any one could reasonably deduce from such facts as these, we should still be justified in saying that the process is so slow, so uncertain, and so partial, that no account ought to be taken of it in surgery.[3]

It is therefore necessary, in every case in which a sequestrum forms, that a surgical operation should be undertaken for its removal. The word *sequestrum* is here used in its strict sense, to express a portion of dead bone contained in a case of new bone. An *exfoliating* portion of bone may separate and be thrown off by the natural processes, though it is usually necessary to facilitate its removal when loose by incisions.

A question is sometimes raised, whether it is prudent to operate as soon as the operation is possible, *i. e.*, as soon as the bone is loose, or whether a certain time should not rather be given, in order that the newly formed bone may become consolidated, and the limb sufficiently strong to perform its functions. The question, however, is rather fanciful than practical. No harm appears ever to result from taking away a loose piece of bone, but much mischief often follows on its being allowed to remain. If, in rare cases, the bone is left too weak to bear the weight of the body or the motions of the limb, it is probable that this is a consequence, either of such extensive destruction of periosteum as finally to preclude reproduction, or of some constitutional fault, or other predisposing cause. The inflammation excited by the presence of the sequestrum in the neighboring bone has probably not passed the stage of softening; while, from the same low rate of the morbid processes, the bony deposit furnished by the periosteum has been small in quantity and low in organization. In such a case as this it would appear that the best chance for restoring to the bone its proper density would be afforded by the operation which would relieve it of the cause of the inflammation whereby its cohesive power is being destroyed. It would, therefore, be far more rational to remove the dead bone, and put the limb at rest, than to leave the source of irritation, and expect a cessation of the effect from perpetuation of the cause.

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[1] Heine, in Gräfe und Walther's Journal, Bd. xxiv., p. 527, quoted by Wagner, op. infra cit., 146.

[2] A case showing this absorption very clearly has been put on record by Prof. Cleland, in the Brit. Med. Journ., for Feb. 22, 1868.

[3] It may reasonably be doubted, also, whether the absorption said to have occurred in some of the experiments above referred to did really take place, or whether the whole thing was not a mistake on the part of the experimenters. Gulliver's experiments (Med.-Chir. Trans., vol. xxi.) show that portions of loose bone, thrust into the tissues of living animals, may remain an indefinite time without experiencing any absorption, as proved by careful weighing at the beginning and end of the experiment. Again, cases such as that quoted on p. 143 prove that a portion of bone, of no extraordinary size, may remain necrosed during a great part of a lifetime, and suffer no perceptible diminution in size. This is the case even when its mechanical connection with the rest of the body is not entirely destroyed. But surely when loose and separated from the living tissues it must be still less under the influence of the vital actions. In a paper by Mr. Savory, in the Med.-Chir. Trans., vol. xlvii., several experiments are described, showing that the absorption of dead bone driven into the living bones of animals, is proportional to the pressure to which it is subjected, a condition which hardly exists in the cases of necrosis that occur in practice.

It is not always easy to determine the question, whether the bone is loose or not, since the growth of the periosteal sheath, or even the shape of the loose portion, and the arrangement of the parts around it, may prevent it from moving under the probe. Of this fact an instance has been given above (p. 149), and the reader may consult a clinical lecture by Mr. H. Smith, Medical Times and Gazette, March 22, 1862. In cases, therefore, where the disease has lasted so long that the separation may be reasonably expected to be complete, it is right to endeavor to remove the bone, even although the probe has not given decisive evidence that the operation can be carried out.

It is necessary here to say something respecting the agents, and the manner, of regeneration of bone after loss of substance from necrosis. In doing this, however, it would be impossible in an essay of this sort, to go into the question with any approach to completeness; but it is hoped that enough will be found in the following paragraphs to illustrate the points necessary for practice. The student who wishes to learn more about the matter is referred to the works of Troja, Weidmann, Flourens, Syme, and Wagner.

The most important agent in reproducing bone lost by necrosis is, without doubt, the periosteum; and this membrane is sufficient of itself to replace all the ordinary exfoliations and partial necroses which follow injuries, etc. The osteogenic properties of the periosteum, when in contact with the bone, have long been known, in fact must have been apparent when the function of the membrane was first studied; and that periosteum, when separated from the surface of the bone, will still generate new bone, is no very novel discovery, since John Bell seems to have been perfectly acquainted with the fact, and describes the formation of a bony cyst by secretion from the detached periosteum, around a collection of blood which had dissected off that membrane from the bone;[1] and the experiments of Syme and Stanley are well known. Lately the osteogenic powers of periosteum have been placed in a very striking light by the experiments of M. Ollier, of Lyons.[2] He has shown that, in rabbits, portions of periosteum may be entirely detached from the bone, and pushed into the cellular tissue of the limb, or even grafted into remote parts of the body, or into the body of another rabbit, and that bone would be generated from the fragment of periosteum in this novel position. He has even succeeded in producing bone by such grafting of portions of periosteum kept for more than an hour out of the body.

It is far from certain, nay, it is most improbable, that any such results could be produced in man, since the conditions of all reproductions, and especially of reproduction of bone, are known to differ so much in man and animals; but, even if the vitality and osteogenic power of the periosteum be less in the human subject than in the lower animals, still it seems reasonable to infer, from observed phenomena, that that power is of the same nature; so that these striking experiments may serve to fix more firmly on the attention of surgeons the importance of preserving the periosteum in cases where the reproduction of lost bones is in question. In all cases, then, where loss of substance in bone has taken place, or where the bone seems deprived of life, it is of the greatest importance that the periosteum should be preserved, a point which will be noticed again in the essay on EXCISION, in speaking of sub-periosteal resection.

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[1] The Principles of Surgery, by John Bell; a new edition, by Charles Bell, 1826, vol. iv., p. 406. The pathology of the case, as related by the author, is sufficiently obscure; but the case may be used to show that Bell knew that bone could be formed from the detached periosteum.

[2] British Medical Journal, 1860, pp. 398, 438; Traité de la Régénération des Os, Paris, 1867. I may mention that some of M. Ollier's experiments have been repeated and verified by numerous experimenters, amongst others by myself.

It has frequently been made a question, on what this power of reproduction depends, whether on the action of the fibrous membrane itself, or on the detachment, together with its lower strata, of small particles from the surface of the bone, which serve as nuclei, around which new bone grows. It is not easy to prove that such nuclei are not detached in every case; but there is no evidence that such is the fact. Bone has often been known to be produced from portions of periosteum which had been previously carefully examined, and no such particles found; while in other cases it has appeared probable that the periosteum had carried fragments of bone away with it. M. Ollier considers that a "subperiosteal blastema" exists naturally between the periosteum and bone, and that this is the source of the deposit.

The periosteum, however, although the most important, is not the sole agent in the reproduction of bone; so that it may be confidently expected that bone will be reproduced in healthy subjects, even though the periosteum be extensively destroyed; but the reproduction will not be so complete as if that membrane had been left. Such a process of reproduction may often be watched in cases where the soft parts have sloughed after scalp-wounds, and have left the cranium exposed.[1] The accident will often be followed by exfoliation from the surface of the bone; granulations then shoot up from the bony surface so exposed, and these are joined by others which advance from the soft parts in the neighborhood: a fibrous cicatrix is formed which can be felt gradually hardening and ossifying. If an opportunity occurs for examining it after the lapse of some considerable time (say half a year), it will be found that the fibrous tissue of the cicatrix is ossifying at its deepest part, and scattered granules of bone will probably be met with at various parts of the cicatrix.

This process may go on even when the bone and periosteum have been removed by operation, as in the wounds of resection,[2] but is much more active when previous inflammation has been excited in the medullary tissue and surrounding soft parts, during the action necessary in order to eject a piece of necrosed bone. In fact, speaking generally, the process of reproduction after necrosis is beyond comparison more active than after injury or operation. Thus, when necrosis has preceded the operation, whole bones of the forearm have been removed, and yet a useful limb has been preserved.

In a case which I had an opportunity of seeing, in which Mr. Savory removed the entire shaft of the radius on account of necrosis, leaving the articular ends,[1] the bone had grown from each of these ends to so great an extent that in eight months after the operation there remained an interval of only an inch and a half, and this appeared to be gradually, though slowly, contracting. This and several similar cases will be found quoted in Wagner's treatise above referred to, and may serve as an encouragement for boldness in our attempts to save limbs after extensive necrosis.

The exfoliation of diseased portions of bone, such, for example, as takes place so frequently in the course of extensive strumous disease, when a portion of the ulcerated surface is cut off from the rest, and therefore perishes, is not generally accompanied by any of that reparative effort which forms part of the process in a more healthy condition. The mere presence of necrosis in such affections is of comparatively little importance; possibly the removal of the dead part may be advisable (but only if it can be done without much violence), but the operation cannot be expected to cure the disease, since the necrosis is not its cause, but its effect. Nevertheless considerable improvement may, in appropriate cases, be expected to follow on the removal of the dead portion, which must always act as an irritant; and the exposure of the carious surface is also very frequently the starting-point of a more healthy action. Hence when bone is felt exposed and dead, it is usually advisable to endeavor to remove it, even although the surface around it is known to be carious.

The above description applies to necrosis in its more usual form. But besides this common chronic form of the disease, an affection which deserves the name of *acute necrosis* is sometimes, though not very often, met with. The destruction of all the soft parts surrounding a small bone, as a phalanx in acute neglected whitlow, will of course lead to the exfoliation of the whole of it, and to this affection the name of acute necrosis is sometimes given. There is nothing, however, in the pathology or treatment of such a disease to call special attention to the bone. The rapid and tensive inflammation threatens other parts of equal importance—the joint, the tendons, nay, in some cases even the skin—with destruction; and the free evacuation of the products of the inflammation is the only measure from which any good can ration-ally be expected. But there is a less-known class of cases in which larger bones are involved in rapid destruction, without known cause, or from causes apparently quite inadequate; and such cases involve not merely local mischief, but very grave danger to life. Many such cases of rapid necrosis are the result of that diffuse inflammation of the periosteum which has been described above; but in others which I have had an opportunity of seeing, I have failed to detect such a cause for the death of the bone, or indeed any cause to which so extensive and so universal an action could reasonably be ascribed.

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[1] See Wagner, On Repair after Resection of Bones (New Syd. Soc.), Appendix, p. 241, for a case in which this form of reproduction is well described.

[2] See Wagner, op. cit., p. 156.

[1] See Wagner, op. cit., p. 243.

Such a case was the following: A stableman was admitted into St. George's Hospital on account of disease in one foot. The history was obscure, but it seemed certain that little more than three weeks before his death the foot was comparatively well, as it was to an injury supposed to have been received twenty-two days before his admission, in running violently down the stable-yard, that the disease was attributed. There was œdema, swelling, and pain over the dorsum of the foot; and this condition was attributed to diffuse cellular inflammation, and treated by superficial incisions, which did not penetrate the periosteum. The man died, with symptoms of pyæmia, but no secondary abscess, twenty days after his admission. On examining the foot, all the tarsal bones were found loose, and grating on each other like stones in a bag; the cartilages between them had almost entirely disappeared. On section, the bones were of a dark-gray hue, and some slight trace of pus was seen here and there in the interior, but no such distinct indication of inflammation of the lining membrane of the cancelli as to deserve the name of osteo-myelitis; nor was the periosteum thickened, vascular, or separated from the surface of the bone by either lymph or pus in any appreciable quantity. The surfaces of the bones exposed by the removal of the articular cartilages were ulcerated, but not deeply. The bones were of their natural consistence.

Is such an affection as this amenable to any treatment? This seems doubtful, if it be conceded that cases of acute necrosis really exist in which the affection is different from diffuse periostitis. In the latter affection timely incisions may succeed, as has been already said, in checking the effusion and restoring the nutrition of the bone; but if the whole bony tissue be involved at once, what agency can be reasonably expected to restore it to health? It is clear that the main question in such a case is, whether the patient's powers will endure the strain of the disease, so that the bone may be cast off, and he may have the chance of its reproduction, or whether amputation will give him a better prospect of life. But the prognosis of an amputation undertaken under such circumstances would be in the highest degree unfavorable, since the condition of system in which such grave results can follow from such trivial injuries leaves little prospect of bearing up against so serious an injury as the removal of a limb; and the tendency to pyæmia is so strong that it is impossible to say that that condition of the system may not be actually present, though latent, when the operation is done. It will, therefore, in most cases, be judged better to support the patient's strength by a liberal allowance of tonics and opiates until the graver dangers have passed away; and then, if the usefulness of the limb is hopelessly destroyed, to remove it when the patient has rallied from the typhoid condition in which the disease commences. Incisions may not have the power of averting the death of the bone, but they ought to be made to an extent sufficient to liberate all tension, and that for two principal reasons—partly in order to avoid sloughing of the periosteum, and consequent destruction of the nidus in which the new bone is to be formed, partly to provide a ready way for the pus, which must form, to escape, and for the examination of the bone and its eventual extraction.

Acute necrosis, whether resulting from diffuse periostitis or not, may be treated by the extirpation of the whole bone so affected, a very free incision being made through the periosteum, which will be found completely separated from the bone, and the bone being, if necessary, divided by a chain-saw passed underneath it. In cases of necrosis of the entire diaphysis of a long bone, a slight twist with the lion-forceps will detach the dead portions from the epiphyseal lines above and below. In this way I removed successfully the whole shaft of the tibia (seven and a half inches long), at the age of ten, one month after the commencement of acute periostitis, with very successful results.[1] I think, when we have clear reasons for believing that the necrosed bone will be found loose, its early removal is most desirable, and liberates the patient from great dangers, both in the present, from the acute surgical fever kept up by the irritation of the diseased bone, and in the future, from the risks incident on the numerous and severe surgical operations which will probably be necessary for the removal of so extensive a sequestrum. I do not recommend the operation when a portion only of the diaphysis has perished, and has not yet separated. The old idea that it is necessary to wait in these cases for the formation of a periosteal sheath of bone, is sufficiently refuted by my cases and that of Mr. J. Bell, which show that even in so large a bone as the femur a great portion (and I do not see why not the whole, if such a case should occur) of the entire circumference of the shaft may be removed, and the limb be left perfectly flail-like after the operation, and yet entire consolidation and perfect usefulness of the limb may finally result.

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[1] Lancet, 1866, vol. i., p. 340. See also Surgical Treatment of Children's Diseases, 2d edit., p. 391 et seq.; where other instances under my own care are related; also a case by Mr. Joseph Bell, Brit. Med. Journal, May 2, 1868, very similar to a case of mine in the femur, but more extensive.

CONSTITUTIONAL AFFECTIONS.

Scrofula in bone.—There are two forms in which scrofulous affections of bone are met with: viz., either a deposit of tubercle, or a low inflammation of the osseous substance; and there is good reason for considering the former as a consequence, or effect, of the latter. Let us, then, first consider the peculiar or distinctive characters of scrofulous inflammation of bone.

A scrofulous bone, when examined in the early stage of the disease, is soft, light, and oily; sometimes more highly charged with blood than natural, and occasionally (though only rarely) presenting a deposit of tubercle in its interior. Bones in this condition are constantly met with after the removal of scrofulous joints; the substance of the bone is easily cut with a knife, and the cancelli are large, and charged with a red jelly-like mass of débris. The inflammation readily passes into ulceration, or caries, and the bone then exhibits on its surface a number of minute pits, or depressions, from each of which the ulceration extends, so as to communicate with those around, until an extensive worm-eaten surface is exposed,[1] soft and rotten on its exterior, bleeding readily, and giving exit to a foul-smelling ichorous pus, in which pieces of decomposed bone can be felt, as gritty particles under the fingers. The periosteum becomes detached and thickened, and is gradually converted into a gelatinous mass of granulations.

The minute changes in the ultimate tissue have been ably described by Dr. Black, in a series of researches to which my own observations lead me to assent. The cancelli are dilated, and they, as well as the lacunæ and canaliculi, are filled with exudation. Occasionally, minute projections of bone from the walls of the cancelli indicate an attempt at the reproduction of bone, and that healing by sclerosis which has been already described as one of the usual events of healthy inflammation. The leading features, then, of the pathological anatomy of strumous inflammation are the same as those of osteitis in general; and the only distinctive anatomical peculiarity consists in the nature of the exudation, which chokes up the canals of the bone. Dr. Black has given several analyses, tending to establish these four conclusions: that tuberculosis gives rise (1) to a considerable increase of fat in the diseased bone; (2) to a large diminution of the salts of lime; (3) to a diminution of the organic matrix; (4) to an increase in the soluble salts. For the details of the analysis, the reader must be referred to the original treatise.[1] They serve to illustrate the fact, that strumous is distinguished from common inflammation by the softness, lightness, and oiliness of the affected bone; to which may be added, the greater extent of diffusion of the morbid changes.

The superficial caries, during the mere presence of which the bone, if the affection be not very extensive, is possibly still in a curable state, spreads gradually inwards, and then the condition of the bone passes beyond the possibility of repair. Large abscesses form, and the whole cancellous extremity, or the whole bone if it be one of the cuboid bones of the tarsus or carpus, is converted into a cavity bounded by a thin shell of osseous matter, and containing bony substance, either in mere débris, or so soft that it will crumble away in maceration. These abscesses are seldom accompanied by that thickening of their walls from periosteal deposit which takes place in simple osteitis; still, at some distance from the seat of profuse suppuration, fresh deposit is sometimes found thickening the bone, or producing anchylosis in joints which enjoy little motion. Necrosed portions of larger or smaller size are often found, but no "sequestra" in the proper sense of that term, as signifying necrosed portions invaginated by new bone.

Such are the anatomical characters of scrofulous inflammation of bone. The other common development of that diathesis in the osseous system consists in the deposit of tubercle, either circumscribed or diffused. Circumscribed tubercle[2] (much the rarer form) seems most common in the skull, deposited on the outside of the bone beneath the periosteum (the strumous node); and next to this its favorite locality is in the cancelli of the joint-end of some bone, generally the tibia. No inconvenience seems to be produced by such tubercle till it softens; and then, if situated in the articular end of a bone, it usually makes a passage into the neighboring joint and destroys it; if on the skull, the softening of such a tubercle forms a cachectic abscess difficult to heal, bordered by indurated cellular tissue, with cold, bluish edges, and leading to exposed and roughened bone, which, however, has not the peculiar feeling of necrosis, and is not at first dead, although it is liable to become so. The deposit of diffused tubercle is more common in the shafts of the long bones. It fills up the cancelli, appearing as a nodulated, or granular, yellowish mass of soft consistence, and extends frequently along the whole length of the shaft. My own impression is, that this diffused tubercle less frequently and less rapidly softens than the circumscribed; but exact information on this point is wanting. It should be remembered that when the shaft is attacked by this or any other form of disease, the extremities usually escape, and *vice versâ* —a matter of great importance in the treatment of diseases of the joints.

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[1] For the appearance of scrofulous ulceration in the macerated bone as contrasted with simple ulceration, see figs. 575, 576, p. 135.

[1] On the Pathology of Tuberculous Bone, p. 32. Edinb., 1859.

[2] Tubercle in bone is, in any view of the case, rare. Rokitansky's statistics, referred to in vol. i., p. 163, give a low place to the bony system as a seat of tubercle; though they place the bones and periosteum consid-

It has occurred to me, though hitherto only on two occasions, to meet with a particular form of ulceration, which was in one case certainly,[1] and in the other probably, connected with scrofula. Numerous pits were found on the articular surface, varying in depth, but confined to the epiphysis, with sharp edges, and curdy purulent contents. Their openings into the cavity of the joint were cleanly punched out of the cartilage, and all the cartilage around was quite healthy. A few small granules of bone were met with among the contents of the cavities. In one of the cases, when the bones were examined, there were found several spots of vascular and softened tissue beneath the surface of the bones, evidently the commencement of similar pits. There was no trace of tubercle. The thigh was amputated, and the patient recovered for a time, but soon died of phthisis. In the other case, the patient, a boy under the care of Mr. Thomas Smith, recovered after excision of the knee, and remained long afterwards in good health.[1]

I believe this pitting or spotted ulceration of the articular ends of bones to be one of the forms of scrofulous disease, and to be indistinguishable from its other forms before dissection. It presents a very favorable condition for resection, from the strict limitation of the disease to a very slight depth below the surface.

Symptoms.—Of the symptoms of scrofula in bone little need be said here. The general symptoms of the diathesis, added to an indolent swelling of some bone, lead to a diagnosis not to be mistaken. The swelling is composed partly of the engorged soft tissues, and partly occasioned by real enlargement of the bone. The color is usually white and pasty,[2] and the swelling indolent; but sometimes, when the inflammation is higher than common, and suppuration imminent, redness and pain may be present. When suppuration has been effected, the pain generally subsides, and the functions of the part are more or less completely regained, even when the bone is destroyed to a considerable extent.

Treatment.—The treatment of scrofula in bone offers little that is peculiar. For local treatment, perhaps the most important indication is to keep the part at rest by splints and bandages during the prevalence of inflammation. Local depletion should be cautiously used while there is pain, tenderness, and superficial redness, or the part may be enveloped in a large warm poultice or fomentation. When inflammation is not apparent in the soft parts, but there are signs of its presence in the bone, it will be necessary to use counter-irritation by caustics or blis-

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erably above the testicle and epididymis, which is hardly in consonance, I believe, with the experience of most surgeons. But the nature of the deposit generally spoken of as tubercular is the subject of much difference of opinion among different pathologists. Dr. Wilson Fox says: "These limitations of tubercle have proceeded so far, that, if the exclusion of the different forms from the category of tubercle, proposed by various pathologists, were simultaneously carried out, tubercle would—not, unfortunately, cease to exist—but would certainly have no longer any place in our nosologies; for nearly every pathological product hitherto ranked under this title, from the gray granulation to the yellow granulation and the cheesy infiltration, is by some authority or other excluded from the category of tubercle."—Artificial Production of Tubercle, p. 22. My opinion is, that many of the deposits which are usually regarded as tubercles in bone, are masses of inspissated pus mingled with other inflammatory products; and that, rare as tubercle in bone is generally said to be, it is in reality still rarer.

[1] A notice of this case will be found in Path. Soc. Trans., vol. x., p. 217.

[1] This is figured in the work above referred to, On the Surgical Treatment of Children's Diseases, p. 488.

[2] The "white swelling" of old authors was named from strumous disease of the joints, though many other affections came to be included under the term.

ters; or in less severe and more chronic cases by means of the tincture of iodine, or other stimulating application. When irritation has subsided, pressure by means of strapping will be found very serviceable, both in ensuring rest and in promoting absorption, and the local action of mercury (Scott's bandage) may be combined with this. By these simple measures, with judicious constitutional treatment, most of the cases of strumous inflammation, which are seen before the occurrence of suppuration, will be brought to a favorable issue.

When the suppuration is once established, it is better to procure exit for it by small incisions, and to use every precaution to prevent the denudation of fresh portions of bone. The question, however, of the early or late opening of abscesses connected with strumous bone is one on which a good deal of difference of opinion very naturally exists, and which is best determined in each individual case. If such abscesses are allowed to go on increasing, the soft parts may be extensively undermined, the disease may extend to fresh bones, and an opening may form in a disadvantageous situation. If opened early, the cavity may be attacked with inflammation, which, if the abscess be large, may even prove fatal. If, however, the abscess be near an important organ, as a joint or serous cavity, then undoubtedly no time should be lost in evacuating it. Large openings should be avoided; but the introduction of a piece of lint, or a drainage-tube, will keep the discharge flowing; or the abscess may be emptied by means of a trocar from time to time, and the access of air thus effectually precluded. When the bone is exposed through the opening of an abscess, its condition should be thoroughly investigated, once for all, with the probe, in order to judge of the necessity for operative interference; but nothing is more mischievous than repeated meddling with diseased bone. The general indications for operations upon bones affected with strumous caries, and the form of operation indicated, will be the same as in caries depending upon other causes; but the prognosis will be less favorable than when the constitution is unaffected, and therefore operations should be undertaken with more caution. Operations on these cases will usually succeed or fail according as scrofula has attacked the viscera or no, and according to the extent of its diffusion through the system; but even after a successful operation the patient is by no means secure against a relapse in some other part.

For the general treatment the reader must be referred to the essay on SCROFULA.

Syphilitic affections of bone.—The chief phenomena of the syphilitic affections of bone have been already spoken of summarily under the head of Tertiary Syphilis (Vol. I., p. 224); it will therefore only be necessary here to go a little more into detail as to the anatomy of bone affected by syphilis, and the means by which the disease is to be diagnosed. As the general treatment of syphilis has been laid down in Mr. Lee's essay, only the local treatment of its manifestations in the osseous system will be dwelt on here.

Syphilitic affections are those in which the existence of a chronic limited inflammation of the periosteum alone is most clearly proved, if, indeed, such inflammation be not peculiar to syphilis. Strumous nodes (as we have just remarked, p. 158) are formed by scrofulous matter confined between the carious bone and its periosteum, and are due to an affection of the bone; but the true node, that which follows syphilis, is caused by the effusion of lymph between the bone and periosteum, and is due to inflammation of a limited portion of the deeper layers ("subperiosteal blastema") of the latter. Hence it is of a different signification from that of a strumous abscess; for while the latter is merely a consequence of diseased bone, and necessarily involves corresponding loss of substance and the slow processes by which alone an ulcer (and more especially a strumous ulcer) in bone can be healed, the syphilitic node is itself the starting-point of the disease in the bone, and if early and properly treated, the whole organ can be restored in a short time to a state of health. But although in a node the inflammation is usually limited to the periosteum, it is not always so. Numerous preparations show thickening of the substance of the bone beneath nodes,[1] proving the implication of the deeper structures, and therefore a state of disease which, though still curable, may be expected to be more obstinate than mere periosteal effusion; and if the skull be examined in the situation of a node, some roughening of its outer table may generally, perhaps always, be discovered. The progress of nodes, when they are not absorbed under appropriate treatment, is in one of two directions: either the subperiosteal effusion ossifies, or it softens and gives rise to caries, accompanied usually by suppuration. The former event is commoner on the tibia, the latter on the skull. The indisposition of the pericranium to form new bone is a very well known fact in pathology, nor am I aware that the formation of new bone in syphilitic nodes of the skull has ever been proved, though new bone may be sometimes found deposited on the outer table of the skull in the neighborhood of large ulcers;[1] in nodes of other flat bones also, ossification, if it occurs, is rare. Many nodes appear so hard as to be pronounced osseous; but the feeling is often deceptive, since the tense and thickened periosteum raised by semi-solid effusion gives a sensation hardly to be distinguished from that of a bony swelling. Therefore, in a hard node which is of no long standing, treatment for its removal may be confidently recommended, and all the more if the swelling be situated on a flat bone. On the tibiæ nodes are prone to ossify, and then the deeper ossified part remains as a permanent irregularity on the surface of the bone; but the unossified portion may often be dispersed by appropriate measures. When a node softens, and the question occurs whether pus has formed, the case ought to be carefully examined, in order if possible to determine the point. The principal indication of the presence of pus is the shining, tense, and thinned condition of the skin. It is important to obviate more destruction of the skin than is inevitable on the bursting of the abscess, since such sores are very difficult to heal, and in some cases appear incurable. The best way is to make a very small puncture, and close it after drawing off the pus. Frequently, under the proper treatment, the soft parts will adhere again to the bone with very slight or no exfoliation.[2] It is especially in these cases of abscess communicating with the surface of a bone that I have found the treatment by carbolic acid, recommended by Professor Lister, most successful. In several cases under my own care where I have had either positive proof or the strongest reasons for concluding that the abscess was connected with diseased bone, I have found the abscess heal readily, and without exfoliation. Many others have also been put on record by Professor Lister and other surgeons. Very commonly, however, the formation of periosteal abscess after a node is followed by the exfoliation of most of the adjacent bone. Syphilitic nodes are usually preceded, and always accompanied, by more or less of dull aching pain in the bone, especially liable to exacerbations at night; or this "syphilitic rheumatism," as it is sometimes called (the *douleurs ostéocopes* of French authors), may be the only symptom referred to the osseous system during the progress of the secondary affection. Mr. Parker[1] is inclined to refer the pain to a syphilitic inflammation of the medullary membrane.

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[1] St. Thomas's Hospital Museum, series c, No. 54.

When the syphilitic cachexia is further advanced, the whole bone or a great part of it may be diseased through its entire thickness, leading to chronic osteitis, and terminating in sclerosis, or what is sometimes called "hypertrophy" of the whole thickness of the bone. I am not aware of any distinction which could be drawn between such instances of chronic inflammation and those arising from non-specific causes, except that which is founded on the presence of concomitant and preceding syphilitic symptoms in other organs.

Still more grave and more obstinate developments of tertiary syphilis in the bones are those carious and necrotic affections (ulcerative or gangrenous) which so often attack the skull, the bones of the face, and the superficial long bones, in persons much reduced by excesses, or by the injudicious administration of mercury. In former times, under the horrible system which prevailed in the "foul wards" of the great hospitals, where every person laboring under any disease supposed to be caused by promiscuous intercourse was compelled to take mercury to salivation, the ravages of syphilis on the bones were dreadful; and it is to this system that we owe many of the preparations of syphilitic caries and necrosis preserved in our museums. But there seems no reasonable doubt that such affections do also occur in persons who have never taken mercury,[2] especially when the disease has been allowed to go on unchecked, and the constitution is at the same time enfeebled by alternations of debauchery and hardship, as is the case sometimes with sailors, and more frequently with prostitutes.

[Fig. 586, taken from a specimen in the New York Hospital cabinet, illustrates the fearful destruction which syphilis may sometimes inflict on the bones. "The disease was found to have destroyed almost the whole of the petrous portion of the temporal bone. The dura mater had either been absorbed or decomposed, and an immense collection of pus extended along the whole base of the brain. After maceration, the remainder of the temporal and a large part of the left half of the occipital bone, extending into the foramen magnum, the left portion of the body of the sphenoid and a part of the

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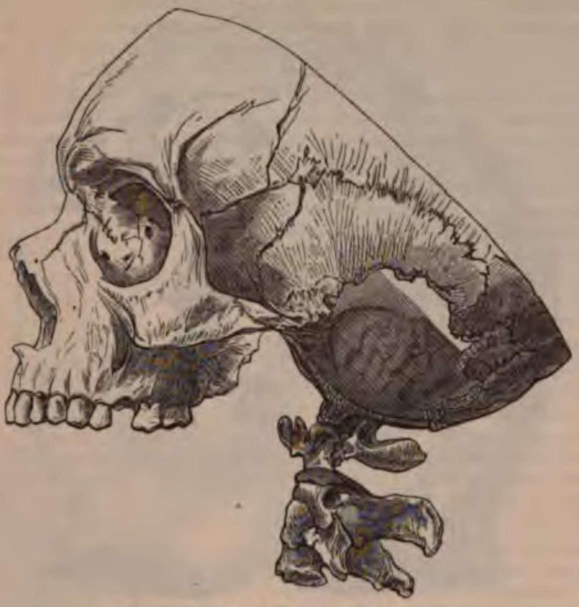
[1] Even here it is in most cases doubtful whether the deposit has been formed outside the skull, or whether the thickening is not produced by deposit within the diploë expanding the outer table; for deposit in the diploë is exceedingly common. See below on the "tuberculated" form of syphilitic ulceration in bone.

[2] See Parker, Modern Treatment of Syphilitic Diseases, 4th ed., 1860, p. 291.

[1] Loc. cit.

[2] See Parker, op. cit., p. 281.

[Fig. 586.



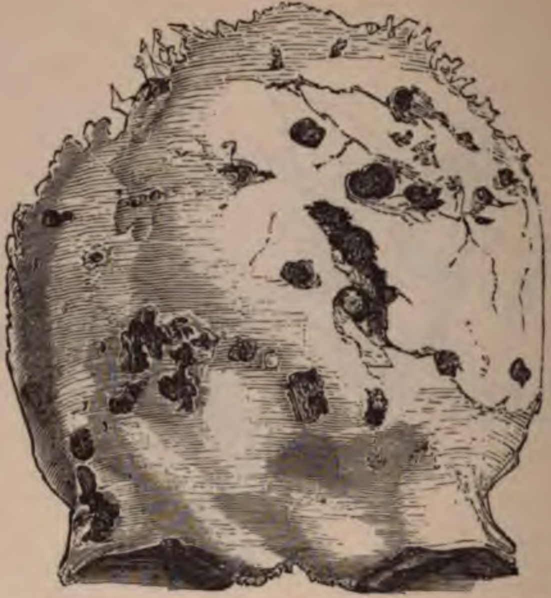
Destruction of bone by syphilitic disease.

arch of the atlas, were found to have crumbled to pieces, thus leaving a hole admitting the closed fist."]

The diagnosis of syphilitic affections is usually easy from the history of infection and the presence of other symptoms; but it may in some cases be obscured by the patient's unwillingness or inability to reveal the history of the original disease. Thus the pains in the bones may be referred to rheumatism; but here the diagnosis can in most cases be easily established by observing that rheumatic pains in the bones are generally accompanied by affections of the thick fibrous structures (muscles or fasciæ) and of the joints; or, if the rheumatic affection be more acute, the urine and sweat will probably furnish indications of the nature of the disease. When nodes have made their appearance, the diagnosis is usually easy, the only question lying between syphilis and struma, since rheumatic periostitis is, as we shall see, more diffused. In the absence of history, the concomitant symptoms will guide us while the skin is unbroken; and after pus has made its way to the surface, some assistance may be derived from the nature of the secretion. Syphilitic caries and necrosis (as has been observed in the essay on SYPHILIS) are not primary affections of the bones, but are the result and termination of nodes, or of inflammation of the bones, or of ulcerative affections of the soft parts around the bone, as in the palate, and therefore have been preceded by a long course of symptoms, during which the diagnosis is usually established. If not, it rarely presents any difficulty, since the traces or the presence of other symptoms of constitutional syphilis can hardly fail to be recognized.

An interesting comparison has been made between the forms of syphilitic ulceration in bone and those of syphilitic eruption on the skin. Specimens of rounded ulcers may sometimes be met with, especially on the skullcap, which bear a strong resemblance to the rupial ulcers so frequent in an advanced stage of constitutional syphilis. A small round spot of ulceration is seen, where the surface of the bone is worm-eaten from the presence of numerous minute depressions, and in some cases the bone around this worm-eaten central portion is marked by arborescent grooves, the traces of increased vascularity. Later on, a circular trench is marked around the worm-eaten spot; and as this widens and deepens, it undermines and finally chisels out the piece, which separates as a sequestrum, and then the bone scars over, leaving a rounded depression, much larger than the original spot, the surface of which is rather glazed and a little vascular, and the bone below it a good deal hardened. In well-marked specimens, these *annular* ulcers, as they are termed by Mr. Paget (fig. 587), look very characteristic, but in less advanced cases, especially before the surrounding trench has formed, or again at a late period when cicatrization has

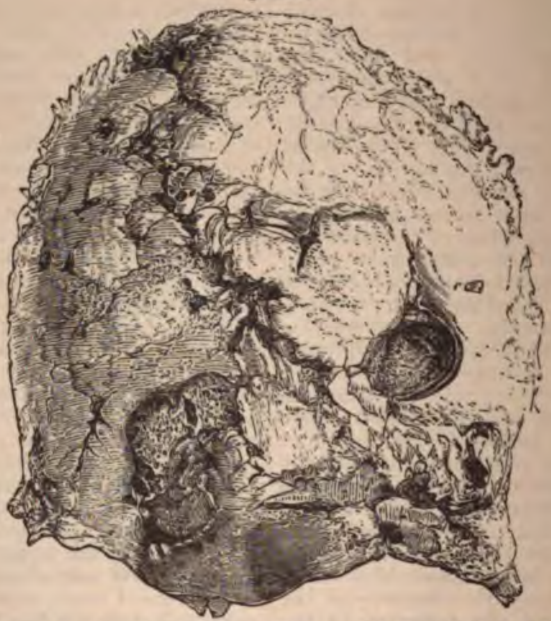
Fig. 587.



Syphilitic ulceration of the annular variety. (Museum of the Royal College of Surgeons, No. 635.)

obliterated some of the more distinctive characters of the ulcers, it seems impossible to distinguish it from a scrofulous or other lesion. The other characteristic form of syphilitic ulceration is the *tuberculated* (fig. 588), which appears to commence by a tubercular thickening of the external wall of the bone, recalling the syphilitic tubercle so common on the skin of the face, etc., and due not to periosteal deposit, but to chronic inflammation of the compact tissue itself. This inflamed

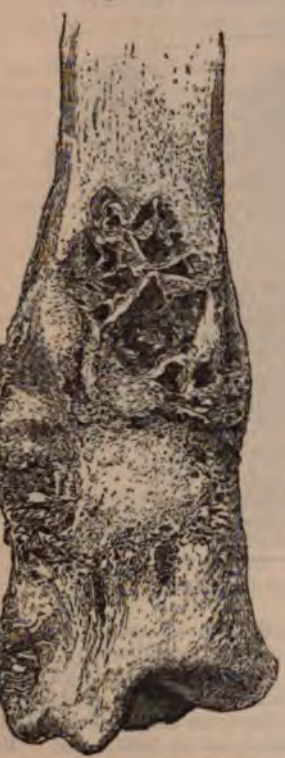
Fig. 588.



Syphilitic ulceration of the tuberculated variety. (Museum of the Royal College of Surgeons, No. 632.)

bone soon becomes dotted over with numerous little pits or depressions, which coalesce and form ulcers, usually oval or round, penetrating deeply into the interior of the bone. Besides these, Mr. Paget has described a third form of syphilitic ulceration, the *reticulated* (fig. 589) in which the disease appears first to show itself in the form of a network of periosteal deposit, which is liable to perforation by ulcers subsequently forming and assuming the annular type, of which latter, therefore, the above may be regarded as a variety. Of the two kinds of syphilitic ulcer, the annular appears to me the more characteristic; but I do not believe that either is so distinctive of the disease as to enable us, with anything like certainty, to infer the previous constitutional affection from examination of the affected bone; nay, I have known pathologists of the greatest experience refuted in such attempts by the subsequent discovery of the history of the preparation.

Fig. 589.



Syphilitic ulceration of the reticulated variety. (Museum of the Royal College of Surgeons, No. 630.)

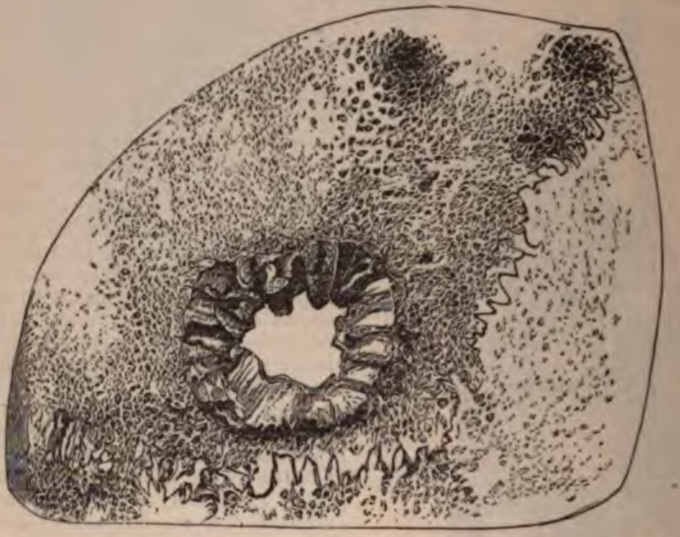
The accompanying figures represent characteristic examples of these various forms of syphilitic ulcer; and by comparing them with those of simple, strumous, rheumatic, and malignant ulceration, which will be found at pp. 135, 165, 183, the reader will be enabled to see at a glance much better than by verbal description, the differences of these affections as shown on the macerated bone.

Any of these forms of syphilitic ulceration may affect the bone so deeply as to penetrate its whole thickness. Thus in the Museum of St. Bartholomew's Hospital is a specimen (A 34) of a clavicle in which the bone has given way (probably after death) in consequence of penetrating ulceration attributed to syphilis. Spontaneous fracture of a long bone, however, from penetration by a syphilitic ulcer, is extremely rare; while penetration of a flat bone, especially of the cranium, is still a pretty frequent circumstance, and used to be an ordinary result of syphilis. In the greater number of such cases no serious mischief follows; the dura mater is exposed on the separation of the necrosed central part of the ulcer, but soon gets covered over, so that its pulsations are no longer visible, and in a little while the gap will be filled up by fibrous tissue. In rare cases, however, pressure upon the brain is produced either by matter confined between the skull and dura mater, or by ulceration laying open a branch of the middle meningeal artery and causing hemorrhage.

[There is, beside these forms of syphilitic bone-disease, a class of interesting cases which occur in the bones of young children with inherited syphilis. These cases have only recently been carefully studied, and for our knowledge of them we are chiefly indebted to Wegner, Parrott, and R. W. Taylor. Three chief forms of the disease have been described, viz., enlargement of epiphyseal ends of long bones, periosteal swellings or nodes on the flat bones, and a general osteitis of the phalanges of the hand or foot, and sometimes of the other bones of the hand or foot. The most common of all is the enlargement of the lower end of radius and ulna. This affection is seen in children from birth to several months old. It is slow and usually painless in its progress, sometimes going on to ulceration of the integuments, and not unfrequently to separation of the bone at the epiphyseal junction. Other long bones are affected in the same way, but less commonly. On the flat bones the swelling is in the form of a flattened node, there being one and sometimes many tumors on the external surface of the cranium. In the bones of the hand, the phalanx, for example, is thickened and enlarged by a rather firm swelling, which sometimes ulcerates superficially, and is also attended with destruction of bone-tissue so considerable as to leave behind it great deformity, if not carefully watched during the cure.

The pathology of all these cases seems to be uniform. It consists in one of those modifications of the process of inflammation so common in the diathetic conditions, in which the actions are arrested at a certain point, and have not the energy to carry them rapidly through the usual stages. The condition of cell-proliferation alone seems to be the feature of the earlier stages, with liquefaction and disintegration in the later. The periosteum is always thickened and inflamed in the diseased region. The minute pathological features of the disease have been carefully investigated by Wegner, Waldeyer, Parrott, and by R. W. Taylor, of New York, whose book on this subject is one of the best and most complete that has been published. The treatment which Dr. Taylor considers most generally useful is the mixed treatment as it is called, he giving bichloride of mercury and iodide of potassium in small doses for long periods of time.]

Fig. 590.



Penetrating syphilitic ulcer. (Museum of the Royal College of Surgeons, No. 636.)

Treatment.—The treatment of constitutional syphilis has been already described, and it has been shown that at one period or other of the disease a prolonged and sufficient exhibition of mercury will be necessary for its cure. To this general rule the affections of bone form no exception, for although some of them are usually found accompanied by so profound a cachexia, so complete a prostration of the whole system, that mercury is inadmissible, it will also be found that such affections do not admit of cure. Iodide of potassium often acts, however, upon the earlier affections of the bone and periosteum like a charm, and the symptoms soon disappear; but those whose experience in the treatment of syphilis is most extensive[1] believe that the improvement is not permanent, and that for the entire eradication of the constitutional affection a mild but prolonged course of mercury (for which the calomel vapor-bath is the most appropriate agent) ought to be insisted on. The local treatment of bone inflamed from syphilis presents several interesting questions. Nodes will usually be benefited by blisters, or if the bone seem to be more deeply affected, by the persevering use of mercurial ointment, strapping with the empl. hydr. cum ammoniaco, iodine paint, etc. But when the pain in the inflamed bone is constant and very distressing, it is quite justifiable to divide the periosteum by a free incision; and then, if nothing is found to account for the tension and to hold out a prospect of its relief, a trephine may be applied to the bone itself, and its medullary canal laid open.[1] If symptoms of cerebral disturbance make their appearance in the course of ulceration of the cranium, the application of the trephine has sometimes been successful in preserving life; but, on the other hand, it is not to be denied that it has sometimes produced or hastened death. The proverbial obscurity of all cranial affections ought, I think, to make us cautious in adopting so extreme a measure as trephining the skull, unless in a patient whose state is otherwise evidently hopeless.

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[1] See vol. i., p. 226; Parker, op. cit., p. 289.

[1] Parker, op. cit., p. 283.

Epileptic convulsions, even with slight symptoms of paralysis, are hardly a sufficient indication for the operation; but the experience of Mr. H. Lee[1] has shown that in some cases the removal of the diseased bone has been followed by the healing of ulcers which had previously been obstinate; and it seems that the removal of the outer table only, when it is dead, and appears to be keeping up irritation, is a safe practice.

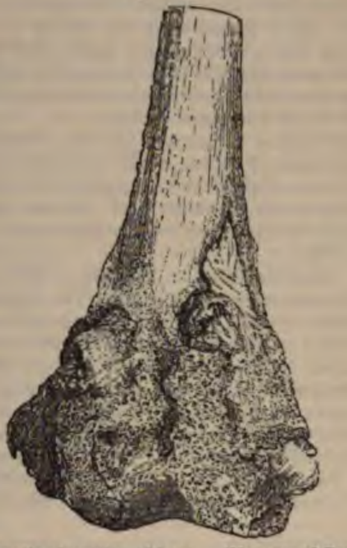
The treatment of fissures and defects of the palate from syphilitic necrosis will be found discussed in a subsequent essay.

Rheumatic and gouty affections of bone.—It is extremely difficult to be certain of the existence of any specific affection of bone due to the rheumatic diathesis. Rokitansky, in his "attempt to determine the characters of the constitutional affections of bone, particularly the inflammations and caries, by reference especially to the appearance of the bone after maceration,"[2] doubts "whether rheumatism gives rise to an inflammation that can be distinguished by any definite character of its products, or to any particular caries, however positively assertions be made on the point;" but there is no doubt that common osteitis is very generally produced by exposure to cold and wet, and other causes, which at the same time generate rheumatism, nor is there any reason whatever for questioning the universal opinion of persons of experience, that those who are the subjects of rheumatism are also those who are most prone to inflammation of the superficial bones, such as the skull, tibia, etc.

The disease now commonly called "chronic rheumatic arthritis" or "osteo-arthritis" is regarded by some authors of credit as originally a disease of the bone. In this work, however, it is considered as commencing in the soft tissues of the joint (see DISEASES OF THE JOINTS).

I would not be understood, however, to deny the existence of an affection which deserves to be called "rheumatic osteitis." The condition of the articulating extremities of the bones in cases of osteo-arthritis is very peculiar, and can hardly be explained by any theory except that of some constitutional peculiarity in the disease, since neither the age of the patient nor the mode of causation of the malady offers any constant features which can account for the singularity of the affection of the bone. That which is most characteristic in all those cases which appear to be rheumatic, is their very slow course, and the great length of time during which inflammation may be present without either caries or necrosis. In all rheumatic affections of the joints, and in many of those of the limbs, although it may be true that the complaint originates in the fibrous tissues, yet the bones will become involved if the disease lasts long enough; and in that case the principal features will be, in the shaft of a long bone, extensive stalactitic or foliaceous laminated deposit from the periosteum, and sclerosis of the superficial portions of the bone; the medullary canal and the deep cancellous tissue being usually, if not always, unaffected. In the Museum of the Royal College of Surgeons, Mr. Paget has classed some specimens[1] as "rheumatic ulceration," in which, along with these appearances on the shaft of the bone, ulceration is seen invading the newly-formed periosteal deposit. One of these preparations will be found represented in fig. 591. In any case, the occurrence of nodes, and of more or less inflammation of the wall of superficial bones in cases of rheumatism, is a sufficiently probable event; but it is a complication which must be treated on general principles. The nodes do not affect the limited extent and rounded outline of those due to syphilis, but are irregular swellings of the periosteum, involving a considerable extent of the surface, and probably some of the thickness of the bone.

Fig. 591.



Rheumatic ulceration of bone. (Museum of Royal College of Surgeons, No. 627.)

The most characteristic effects of rheumatism, however, are displayed upon the articulating extremities; but as this disease will be found fully described in the essay on DISEASES OF THE JOINTS, it will not be necessary to say much about it here.

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[1] Proceedings of the Med.-Chir. Soc., vol. iii., p. 283.

[2] Path. Anat. (New Syd. Soc. Trans.), vol. iii., p. 202.

[1] Nos. 626, 627, 627 A.

The chief features which are distinctive of rheumatic inflammation of the bones are, the extensive deposit of bone in the fibrous structures around, the condensation and thinning of the shell of the bone, the rarefaction and partial absorption of its interior, and the consequent change of shape which parts containing much cancellous tissue, such as the articular heads and necks of long bones, suffer. In the articular disease the new bone is found, to a great extent, in the ligaments and other tissues distinct from the periosteum, and thus forms what Dr. Adams calls "additamentary bones," which have been so often mistaken for portions fractured off the bony prominences, near which they may be situated, and remaining ununited. I shall adduce some reasons for believing that many of the specimens in which portions of bone have been found near the shafts of long bones, but movable upon them, and which have been thought to be instances in which exostoses had been fractured at their base, may be of the same nature.

As to the treatment of the rheumatic affections of bone, nothing need be said here, since all that is necessary to add to the general treatment of osteitis will be found in the essay on DISEASES OF THE JOINTS.

I have nothing to say about the affections of the bones in gout. The deposit of lithate of soda is sometimes found in the interior of the bones in inveterate cases, as well as on their exterior; but its importance is quite secondary. Stromeyer[1] alludes to a case in which nearly all the bones of one side of the body were hypertrophied in a patient who had long suffered from gout; but no opportunity occurred of examining the bones affected.

Mollities ossium.—The peculiar condition of the bones which is known by the name of mollities ossium, or malacosteon, is one which is very rarely met with. In the female pelvis, as a cause of difficulty in parturition, it is less rare than under other circumstances, and demands the special attention of the obstetric surgeon, involving, as it does, some of the gravest questions which are to be solved by that branch of our art. These questions, however, which have reference to the altered relations between the deformed bones of the pelvis and their contents (especially the gravid uterus and fœtus), are not within the scope of the present work. We have only to consider the disease in its pathology and general surgical bearings.

The pathology of mollities is far from being satisfactorily established; and there can be little doubt that this has arisen, in great part at any rate, from the fact that authors have confounded several different conditions under the same name. Some, indeed, make no distinction between mollities and fragilitas ossium; while others regard mollities as an affection allied to, if not identical with, rickets.

The disease which appears best to deserve a separate description under the name of mollities, is marked by the following characteristics. Several bones are usually affected at the same time. The portions of bone attacked are uniformly softened throughout the whole extent of the disease. The disease, however, does not in all cases affect either the whole length or the whole thickness of the bone, and if the specimen be examined at an early period, the outer shell is often found to retain its natural consistence.[1] When the whole bone is affected, it can be readily bent, and resembles, in extreme cases, as Dr. Ormerod[2] remarks, rather a portion of fatty matter enclosed in a case of periosteum than a bone. If the cancellous tissue (in which the disease appears to originate) be examined, it is found that the cells are enlarged, sometimes to such an extent that the whole bone is expanded, and are filled with a peculiar reddish gelatiniform matter, in which, on microscopical examination, much fat and oil can be discovered, together with blood-discs. Besides these (which are the common products of any degenerative change), certain peculiar nucleolated nuclear bodies have been described by Mr. Dalrymple.[3] Instances of bones affected with mollities do, however, occur, in which the amount of fat is not greatly increased. Thus in a specimen in Guy's Hospital Museum (No. 1004^{55}), taken from a case reported by Mr. Solly, in the 27th volume of the Med.-Chir. Trans., it is said that the diseased tissue consisted simply of an organic matrix, with little earthy matter, and containing little fat. Cases like these show that it is impossible to describe mollities as simply a fatty degeneration. Degeneration of some sort is, however, always present; and as this advances, it involves the compact walls of the bone, and then the disease becomes for the first time recognizable, by the symptoms which will be immediately described. At a later period the whole bone is found to be involved, and becomes a mere bag of soft matter enclosed in the periosteum, which, perhaps, may be somewhat thickened, but it does not appear that any further destruction of the bone itself occurs. It is merely converted into a soft, generally oily, material, which crumbles away on maceration, but which seems capable of resisting absorption for an unlimited period during life.

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[1] Handbuch d. Chirurgie, vol. i., p. 442.

[1] As in Dalrymple's case, referred to below.

[2] Brit. Med. Journal, Sept. 10, 1859.

[3] Dublin Quarterly Journal, 1846, p. 85; see also Path. Soc. Trans., 1846–7, p. 148. It is said that in bones affected with mollities, lactic acid and lactates are to be discovered, and that this lactic acid promotes the solution and absorption of the phosphate of lime. The fact, however, appears doubtful. See Drivon, Arch. gén. de Méd., 1867, vol. x., p. 608.

The symptoms of mollities are sufficiently striking in a well-marked case to attract immediate notice, however obscure may be the real nature of the constitutional affection. The patients are, it is said, usually females,[1] and generally past the middle period of life. Repeated pregnancy appears to act as an exciting cause of the disease, and may, perhaps, account for the greater proportion of females.

The disease appears to be, in some cases at least, hereditary. Thus, in the history of Dr. Ormerod's patient, referred to above, it is stated that both the son and daughter were subjects of the same affection. Sometimes pain is complained of in the affected bones for some time before the nature of the disease becomes manifest; in other cases, however, the deformity induced by gradual softening of the bones is the first symptom noticed. When this softening has proceeded far enough, the bone gives way gradually, if it has been equably and thoroughly softened, so as to yield, and become merely deformed; but if the softening has been confined to the internal part of the bone, and the thin outer shell has been left solid, and therefore brittle, spontaneous fracture (or, more correctly speaking, fracture from very slight causes) is liable to occur. The former class of cases, in which the bone bends without breaking, are those in which mollities is most characteristically marked, since spontaneous fracture preceded by pain in the bone is also a feature of malignant and other diseases of the osseous system. In such extreme cases of mollities, the limbs become distorted in the strangest way, so that the thighs have been known to bend till one of the feet touched the head; and from the softening of the vertebral column and bending of the limbs, the stature is very considerably diminished. The constitutional cachexia is often not very strongly marked, and patients will live in this condition for an indefinite period, bedridden from the weakness of their limbs, and the loss of the firm points from and to which the muscles act, but with sufficient mental and constitutional vigor. The cause of death appears generally to be simple exhaustion; or failure of vital powers, like what takes place in extreme old age (in fact some of these patients do not die till the extreme of life);[1] or sometimes functional disturbance, induced by the altered relations of the viscera, and the pressure to which, from various causes, they are subjected. Not unfrequently, however, the patient does not die of the disease at all, but, having lived under its influence for many years, is carried off by some totally different complaint.[2]

With these symptoms it is not surprising that this disease should have been claimed as merely a rarer form of several better-known affections of bone, to all of which it bears some resemblance, however little they may seem to bear to each other. Some authors[3] consider mollities to be merely fatty degeneration, or atrophy of bone; others regard it as rickets attacking the adult; while many class it with cancer. Now each of these opinions has a basis of probability, and it is very possible that many of the cases of so-called mollities might with greater propriety have been entitled "atrophy" of the bone. Of this, Mr. Curling's case appears to have been a good instance; and the difficulty which some authors have expressed in distinguishing between mollities and fragilitas ossium[4] appears to have arisen from their having compared together cases in which there was no real difference, and where the name mollities had been given to simple atrophy.

The connection between rickets and mollities appears, at first sight, a very close one, on account of the bending of the bones, and liability to fracture from slight causes, which characterize both. Some patients, also affected with undoubted mollities, have suffered in their youth from rickets.[1] Still, if we consider the question attentively, the differences between the two affections far exceed their resemblances. Rickets is an affection of early life, closely allied to scrofula in its causation and in its cure; it is peculiarly amenable to treatment; and under favorable circumstances the constitutional cachexia, which is its essence, readily disappears as the child grows. Mollities hardly ever makes its first appearance till after middle life; and, even in those cases where the patient has been rickety, not till long after the cachexia of that disease has subsided; it shows no alliance with scrofula, and is not amenable either to the remedies for that disease, or, as far as is known, to any other remedies, but pursues its career steadily, unaffected for good by any medical treatment.

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[1] I do not find quite so great a disproportion between the sexes as is implied in the descriptions given by some authors. Of ten cases of true mollities taken at random, six were females and four males.

[1] See the cases mentioned in the Catalogue of Guy's Hospital Museum, Nos. 1044^{62}, 1098^{50}.

[2] Thus in Dr. Ramsbotham's case (Path. Soc. Trans., 1846–7, p. 148) the patient died of pneumonia, after suffering for more than six years from mollities.

[3] See Mr. Curling's paper in Med.-Chir. Trans., vol. xx., p. 356.

[4] It would be well if the term fragilitas ossium were allowed to become obsolete, since it only describes a symptom common to several affections.

In the latter particular, as in several of its other features, it bears a far stronger resemblance to cancer. In fact there can be little hesitation in classing some specimens preserved in museums as mollities under the head of diffused cancer; and, conversely, in recorded cases of cancer, some of the bones have been found in a state closely resembling, if not identical with, mollities.

Thus in a case of secondary cancer in the spine and other parts, after removal of scirrhus of the breast, related by Mr. Cæsar Hawkins,[2] it is noted that "the centre of the neck appeared a little sunk forward, as if the upper vertebræ had been depressed in that position;" and the anatomy of the affected bone is thus described: "The body of the fifth cervical vertebra was very irregular on its surface, and was softened throughout, with much enlargement of the cells of the cancelli, which were filled with a sanguineous pulpy fluid; the two adjoining vertebræ showed a lesser degree of the same morbid structure."

But, allowing that many of the recorded cases of mollities may be referred to simple atrophy, and some of the others to cancer, there can still be no doubt of the existence of an independent disease to which that name is peculiarly appropriate.

In one such case recorded by Dr. Bence Jones,[1] the leading feature was the peculiar condition of the urine. This attracted attention, together with the state of the patient's general health, long before any alteration in the bones was apparent; in fact, no alteration in them was discovered till after death. The peculiar substance contained in the urine appears to have been closely allied to albumen. Dr. Bence Jones's conclusions on this subject may be quoted here: "66.97 parts of this hydrated deutoxide of albumen were passing out of the body in every 1000 parts of urine. Hence, therefore, there was as much of this peculiar albuminous substance in the urine as there is of ordinary albumen in healthy blood. So far, then, as the albumen is concerned, each ounce of urine passed was equivalent to an ounce of blood lost. The peculiar characteristic of this hydrated deutoxide of albumen was its solubility in boiling water, and the precipitate with nitric acid being dissolved by heat, and re-formed when cold. By this reaction a similar substance in small quantity may be detected in pus and in the secretion from the vesiculæ seminales. This substance must be again looked for in acute cases of mollities ossium. The reddening of the urine on the addition of nitric acid might perhaps lead to the re-discovery of it; when found, the presence of chlorine in the urine, of which there was a suspicion in the above case, should be a special subject of investigation, as it may lead not only to the explanation of the formation of this substance, but to the comprehension of the nature of the disease which affects the bones."

These cases, then, of what we may call true mollities, are distinguished both from atrophy and from cancer by special characters: from simple atrophy by the existence of vitiated secretion, proving the affection of the constitution, and by the presence in the affected bone of special morbid elements; although the latter difference can hardly be appreciated during life, except in those rare instances where the bones are swollen. From cancer they are distinguished by the strict limitation of the morbid product to the affected bones, and by the different progress of the constitutional affection; since the patient, if he dies of the disease at all, dies of the exhaustion produced by vitiated secretion, or from the effects of mechanical interference with the viscera; not, as in extensive formation of cancer, from perverted nutrition, still less from transference of disease to remote organs.

Our knowledge of the true pathology of this complaint is as yet quite deficient, and so it follows that no means of treating it are known. The patient's strength must be supported, and he must be guarded from all exertions and shocks. If bedridden, his position must be accommodated to the shape of his limbs, so as to correct, if possible, the existing deformity by gradual traction, and to prevent any greater distortion. The fractures which occur in these cases are sometimes excessively numerous. Dr. Ormerod's patient had "at one and the same time no fewer than seven fractures of different bones." Yet in this case the fractures used to unite with the same readiness as they do in rickety bones.

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[1] This was the case with Dr. Ormerod's patient above referred to.

[2] Med.-Chir. Trans., vol. xxiv., p. 45. See also a case of cancer of the bones after scirrhus of the breast, described by the author in Path. Soc. Trans., vol. xi., p. 219, in which some of the ribs were perfectly flexible. In examining a case of well-marked cancer of the pelvis, I have found a condition of the innominate bone bearing an almost equally close resemblance to mollities.

[1] Phil. Trans., vol. lxvi., p. 55. This is the same case as Mr. Dalrymple's, already referred to—the paper in the Philosophical Transactions containing the account of the peculiar substance found in the urine.

Many of the cases are hardly subjects for treatment, since the disease in the bones and the distortion of the limbs has advanced to an unmanageable extent before the patient is seen; and it would be scarcely desirable, even if it were possible, to protract the course of a painless but inevitable decay.

Cancer in bone.—All forms of malignant disease are met with in the bones, but the encephaloid, or medullary, is by far the most common.[1] Osteoid cancer is almost confined to the bones as a primary disease, although a very few cases are on record in which it has been found in the soft parts, without any known cancerous affections of the bones.[2] Cancer in bone may be either a primary disease, or secondary on cancer in some other, and usually a remote organ.

[Modern investigation has added much to our knowledge of the true nature of what is called malignant disease, both in the bones and in the soft parts. It has long been agreed by pathologists that those tumors which show either local recurrence after complete removal, a disposition to spread into and to involve neighboring tissues, a disposition to involve the lymphatics, and particularly the lymphatic glands, or a tendency to appear in distant parts, either before or after removal, shall be classed as the malignant tumors. It has more recently become evident that these evil qualities are not all possessed by all the tumors that possess some of them, and that the tumors which do possess one or more of these bad features do not possess them all in an equal degree, and finally that several forms of tumors possess them only occasionally, and as it were accidentally. Hence has arisen the distinction, clinically proper enough, into malignant and semi-malignant tumors.

It has not yet, however, been possible to arrange these various growths in such a manner that a given anatomical shall correspond to an observed clinical character, or to deduce the clinical history from the ascertained anatomical structure, or on the other hand to predict, with any approach to certainty, from a recorded clinical history, what the microscope will reveal as to its histological characters. From this it must be manifest that we are not yet in a position to classify tumors, either on the anatomical or on the clinical basis, in such a way as to make the classification perfect for our practical guidance.

Nevertheless, much has been accomplished, and new and valuable light has been thrown upon many doubtful points, particularly in malignant affections of the bones. Thus it is now generally agreed to restrict the term cancer to those growths which are essentially epithelial, and usually alveolar. Thus restricted, the term cancer is found to correspond very nearly to the class of tumors which clinically show, in the most marked manner, all the features of malignancy, viz., local recurrence, local infection, glandular contamination, and generalization. As far as this proves to be true, it must be accepted as a considerable advance in our positive knowledge as to the nature and tendencies of these tumors. But still further it seems reasonable to believe that epithelial cancerous growth can only take place in parts which contain epithelium as an original anatomical element, and that therefore primary cancer cannot occur in bones, in no part of which is epithelium normally found. This view of the histogeny of primary cancer is strongly stated by Prof. Lücke, of Strasburg. He says, "you know that the bones are in no way connected with the outer and inner blastodermic membranes, you can affirm therefore that no primary tumor in bone can be epithelial in character, in short, that there is no such thing as a bone-cancer." He goes on further to say that there are cases in which the primary tumor may occur in those bones which are covered by mucous membrane, the disease commencing in the epithelium of this membrane and extending into the bone. He also acknowledges that where the skin covering a bone becomes cancerous, it may involve the bone in the primary growth. These cases, he says, are rare, and are only apparent, not real, exceptions to his general law, for though the bone may form the chief part of the primary tumor, yet the origin of the disease has not been in the bone, but in the skin or mucous membrane covering it, and when, in any given case, the presence of epithelium can be shown to be impossible, the bone-tumor is not a cancer.

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[1] In the notes of fifty cases of malignant disease of the bones which I happen to have by me, thirty-five are classed as encephaloid, four as osteoid, four as scirrhus, three as epithelial, one as areolar or colloid, one as melanosis of the periosteum, and the other two were tumors of doubtful nature and anomalous structure, but probably malignant. These notes, however, which are composed partly of extracts from books, partly of cases noted on account of interesting features, contain too large a percentage of rare forms of disease. This is evident in the number of cases of osteoid cancer.

[2] See Paget, Surg. Path., vol. ii., p. 496, ed. 1853.

Of course it is understood that these exclusive views as to bone-cancer have reference to primary cancer only. It is conceded that the bones are liable to secondary or metastatic invasion from any and every form of perfect cancer.

The views thus presented necessitate a change in our arrangement of the malignant diseases of bones; and all that has heretofore been considered primary cancer must be allotted to the class of the sarcomata. It becomes, therefore, a matter of great importance to give special attention to this, the most extensive, as well as the most fatal, of all the affections of the bones. The word, as now used, was first proposed by Virchow to denote a tumor originating from the middle or connective-tissue layer of the embryo, which had very much the appearance of granulation-substance, and was composed of undeveloped transitional cells, contained in a stroma varying in consistence from hyaline to almost fibrous, the proportion of cells to intercellular substance varying very greatly in the different classes into which sarcomata may be divided.

To this class of bone-tumors Dr. Samuel W. Gross, of Philadelphia, has devoted a great deal of careful examination and study, and has, in two papers recently published in the Am. Journ. of the Med. Sciences, given us the matured and well-considered results of this conscientious investigation. With regard to the relative frequency of the primary neoplasms of all kinds in the larger bones, he gives the first place to sarcoma, next osteoma; chondroma, osteoid chondroma, fibroma, and myxoma following in the order stated. His observations are confined to sarcomata growing in or on the long bones. Dr. Gross accepts the usual subdivisions into fibrous, myxomatous, lymphadenoid, alveolar, osseous, cystic, etc., but makes a more important division according to their point of departure. Thus he says "they may be separated into the peripheral,—periosteal or periosseous, and the central,—endosteal, intraosseous, or myelogenic; a division which is not only convenient as designating their seat, but which is also justified by the fact that, in general, they present marked differences in their histological construction, and are of different prognostic import." These two classes differ from one another in the fact that one has, and the other has not, a bony case or envelope which, when it exists, keeps pace with the growth of the tumor, rarely, even in the largest growths, being entirely absent. The periosteal tumors are covered with a fibrous or condensed areolar-tissue capsule, and never present any bony shell, and rarely even any superficial ossification of any kind. In shape the central tumors are apt to be spherical, the periosteal assume a great variety of forms. In their clinical history, central are greatly less malignant than peripheral growths. Taking the class of sarcomata as a whole, however, their malignity exceeds that of all other neoplasms except carcinoma of the soft parts; and this malignity is shown by all its usual features, with the exception of the contamination of lymphatic glands, which, as a rule, is not observed in the history of sarcoma. The generalization of sarcoma is one of its most marked features; 46 per cent. of the cases studied by Dr. Gross presenting this clinical feature, the metastatic tumors being found in the lungs, lymphatic glands, and in other parts of the osseous system; the secondary deposits being invariably of the same nature as the primary tumor.

Dr. Gross makes a subdivision of the two great classes of central and peripheral bone-growths according to their histological formation. Thus, of the periosteal class he makes three, viz.: 1st, the spindle-celled; 2d, the round-celled; 3d, the osteoid. And of the central also three, viz., 1st, round-celled; 2d, spindle-celled; 3d, giant-celled. He considers their degree of malignity to be in the order in which they are above named, and states that the periosteal forms are more malignant than the central by 43.5 per cent. Fortunately, the giant-celled, which is the least malignant, is also the most common, 42 per cent. of the whole number belonging to this class. The seat of these tumors in the long bones is by marked preference in the femur and tibia. They are rather more common in males than in females; by far the larger number occur before the age of thirty; and in nearly one-half of the cases studied traumatism is assigned as a cause.

Of these classes, by far the largest is the last mentioned, viz., the giant-celled sarcomata. This form of bone-tumor, first carefully studied by Lebert, afterwards more clearly described by Robin, and still later almost photographed by Eugene Nélaton in his Thése sur les Tumeurs a Myeloplaxes, corresponds exactly to the disease which Mr. Paget has introduced to English students as the myeloid or marrow-like tumor. This term myeloid, introduced by Mr. Paget, was selected by him because he considered that some of its characteristic cells were identical with those which normally exist in the marrow of young animals; and from this, perhaps somewhat strained homology, he inferred its essential benignity. Experience has somewhat chastened Mr. Paget's hopeful views, and it is now generally conceded that while a large proportion of these myeloid growths are to be fairly considered benign, a certain smaller proportion, say about one-quarter, show all the features of the deepest malignancy.

Under the microscope the structure of the giant-celled sarcoma is found to be "a stroma of spindle and round cells, but particularly the former, in which the characteristic multi-nucleated cells are embedded, with the intervention, usually, of little, if any, visible intercellular substance." . . . . "The giant cells themselves are made up of finely granular protoplasm, in which many round or ovoid nuclei are contained; but they differ from them (the normal marrow cell) in their relatively large size, sometimes reaching the enormous diameter of $\frac{1}{100}''$, or even $\frac{1}{80}''$, in the greater number and clearness of their nuclei, which are rendered more apparent by the addition of acetic acid, and in the variety and oddity of their forms, which it is impossible to describe. The contour of the cells seems to be influenced by the density of the intercellular substance, being irregularly spherical, ovoid, or lobulated when the latter is soft, and provided with numerous filiform, branched, or clavated processes, through which contiguous cells are occasionally united, when it is fibroid, in consequence of the protoplasm extending itself into the interstices of the fibrillæ. They also not unfrequently present a reddish-brown discoloration, to which the peculiar tint of the tumor, of which they form a part, is in some degree due."

Much difference of opinion has existed among pathologists, as to the derivation of these peculiar bodies, some believing them to originate from the normal medullary cells, which they resemble, others that they are modified bone cells, others regarding them as derived from the endothelial cells of the vessels; and some excellent observers holding views still different from all these. Dr. Gross, without considering the question as settled, inclines to the belief that they are "liberated and hypertrophied bone-cells," and he supports his view by some very ingenious considerations derived from the gross appearance and history of myeloid tumors.

The surface of the giant-celled growth, in the long bones, is usually smooth, and their shape spherical or ovoid. Their capsule is usually very distinct and firm, isolating them from surrounding tissues, and is composed of a shell of bone which is the original compact tissue expanded over the growing tumor. This bony shell is not always complete, the osseous deposits being wanting in many instances at various points, leaving the capsule composed at those points of a membranous expansion only.

On section the naked-eye appearances are commonly characteristic. The cut surface presents a smooth, glistening, juicy appearance, and a consistence which varies between a firm fish flesh and a soft pulp. Ordinarily not very vascular, in a few instances they are so abundantly provided with large vessels that distinct pulsation is received from them. The most striking feature, however, is the color, which is usually of a chocolate brown or of a maroon shade, somewhat like that of the splenic pulp. The color varies in depth and hue in different parts of the same tumor, and in different specimens presents also gradations of red up to pink. Some points are yellowish, and sometimes the whole tumor has a grayish tint.

These tumors are liable to a fatty degeneration, which, according to its stage of advancement, produces softening of the mass, and which is generally marked by a yellow coloration of the cut surface. Cysts are also found of varying size, and filled with a fluid, sometimes clear, sometimes discolored, with varying shades of red down to a dark reddish-brown. The vascularity of these tumors is occasionally very great, the vessels being dilated, tortuous, thin-walled, and often communicating with extravascular spaces like the structure of the corpora cavernosa. The pulsating tumors of bone almost invariably belong to the giant-celled class.

One very interesting and important feature which Dr. Gross has brought out by his investigations, is the relation of calcification and ossification to the malignity of the tumor in which they occur. He has found that in the majority of cases which present decided indications of malignity, this change has taken place, so that the mere fact of ossification is prima facie evidence of malignity, and its absence a favorable prognostic sign. The change is usually one of calcification rather than ossification, true bone not often being formed. This statement does not include the outer shell which covers and limits the tumor, but refers to interstitial deposits only. Statistics are given which very clearly show the rates of mortality from this form of disease, and the following conclusions are reached, which are presented in the author's own words.

"From the foregoing considerations it will be seen that about 23 per cent. of all cases of myeloid tumors are malignant, and that the degree of malignity may be graded in accordance with the existence or absence of calcareous or osseous deposits, since these were found in the original tumor in four of the five cases of metastasis. Further, it will be observed that the osteoid myeloid tumors are not absolutely malignant, as 43 per cent., or 3 out of 7 patients, remained well several years after their removal. Finally, in this connection it may be stated that of 15 examples of giant-celled sarcoma, in which calcification or ossification is not noted, only one was characterized by secondary growths. Hence the prognosis of the latter is as favorable as is the prognosis of some other neoplasms which are considered to be of an innocent nature."

The growth of giant-celled sarcoma varies greatly in regard to its rapidity, some cases growing very fast, and in others characterized by extremely slow growth. As a rule these grow more slowly than the other varieties of sarcoma of the long bones. The growth is sometimes arrested, as in a case reported by Mr. Hutchinson, in which a tumor of the head of the humerus ceased to grow for four years, and then resumed its activity. Occasionally they disappear altogether, as in a case mentioned by Mr. Paget, in which after the removal of a myeloid tumor of one side of the upper jaw, a smaller tumor of the opposite side gradually subsided and finally disappeared, the patient remaining well when last heard from. A case of partial disappearance occurred in a patient in the New York Hospital, whose thigh was amputated for an enormous tumor of the lower half of the femur which had been growing four months. The tumor, on examination, was pronounced to be encephaloid cancer, according to the views then prevailing (1856). In six months' time the disease returned in the skull, in the clavicle, and in several of the ribs. At one time a note is made, "The swelling on the clavicle has disappeared. The large tumor of the head is also subsiding." Two months later it is stated, "The tumors on the head are gaining a formidable size. That on the clavicle at one time almost entirely disappeared; which was also the case with the swellings on the ribs. The tumors on the head, after their first partial subsidence, steadily but slowly increased." The complete history of the case clearly indicates the tumors to have been of a sarcomatous character.

The relations of giant-celled sarcoma to the lymphatic glands is important and interesting. As a rule the glands are not affected in any part of the progress of the growth. In the few cases noted in which the glands were enlarged, in most the enlargement has been due to irritation, as evidenced by their disappearance after successful operation, or as shown by microscopic examination revealing no specific elements. "The absence of sarcomatous elements from the glands submitted to minute inspection; their diminution or disappearance after operation, the non-occurrence of periadenitis, through which they remain isolable, and unattached to the connective-tissue in which they are embedded; their freedom from ulceration, and their non-involvement in four other examples of general dissemination of the disease, are facts that lead to the conclusion that, in giant-celled sarcoma, glandular enlargement is the effect of irritation and not of specific infiltration, and that systemic infection takes place through the vascular, and not through the lymphatic system." The value of these observations in diagnosis must be evident.

The duration of the disease is so varied in different cases that no very reliable averages can yet be given. Among those who survived operation, however, Dr. Gross gives the average from the first observation of the disease to the date of record as about 55 months, or a little more than four years and a half; the majority of the patients being still alive. In reference to the period of the disease, early operations are not proved to be more successful than delayed ones. Rather the statistics show that the chance of life is better when a long period has elapsed before operation. This, however, is doubtless due to the fact that it is in the slow growing tumors that operation is most likely to be postponed, while in those growing rapidly it must necessarily take place at an early date. Rapidity of growth therefore is probably a more important factor in prognosis than promptness in operation.

These giant-celled sarcomata are the tumors which most frequently present the feature of pulsation. It occurs in about one-fifth of the cases, and is so rare in any other form of neoplasm, that a strong evidence as to the nature of a tumor may be derived from the mere fact of its pulsation. The few instances where pulsation existed in other than giant-celled sarcoma, were cases in which the tumor was a sarcoma, and a central sarcoma, but differed simply in not having the characteristic cells. The diagnosis therefore in every case of pulsating tumor is positive as to its being a central sarcoma, extremely probable that it is a giant-celled sarcoma.

The diagnostic indications are thus summarized by Dr. Gross: "A large, immovable, spherical, slowly growing, probably painful, and possibly pulsating, tumor of varying degrees of consistence, occurring in the articular extremity of a long bone, between the fifth and fortieth years, or at about the twenty-eighth year, unattended by changes in the integuments, or by the enlargement of the subcutaneous veins and lymphatic glands, and not marked by impairment of the general health, may be pronounced to be a giant-celled sarcoma."

2. Central spindle-celled sarcomata identical with the fibroplastic tumor of Lebert, the recurrent fibroid of Paget, and with the encephaloid cancer of many authors, are, next to giant-celled sarcomata, the most common in their occurrence. They are composed essentially of the well-known spindle-cells packed closely together, but lying orderly side by side, and the taper extremities dovetailing into one another so as to form a very uniform tissue, held together by a rather limited but varying amount of hyaline, slightly granular, or sometimes fibrillated, intercellular substance.

The tumors thus composed have very much the same gross appearances as the giant-celled variety, rarely, however, presenting the deep coloration which is so characteristic of that form. They are generally seated in the shafts of the long bones, and appear somewhat later in life than the giant-celled tumors, the average age at the time of their first discovery being thirty-six years. They grow more slowly, and there is no enlargement of lymphatic glands. They are malignant in their course in about 23 per cent. of the whole number of cases. Spontaneous fracture is surprisingly common, having occurred in 44 per cent. of all the cases. Pulsation existed in 12 per cent.

3. Central round-celled sarcoma. This class contains a great number of the cases described by authors as the encephaloid cancer of bone, and is characterized by structure made up of small, nearly equal sized, round cells held together by a small amount of intercellular tissue, through which vessels ramify, thus making the likeness to granulation-tissue upon which some authors may strongly insist. Departures from this typical form, however, are not uncommon. Thus we have a variety in which the cells are contained in an alveolar stroma, so distinct as to be with difficulty distinguished from the alveolation of true cancer. These tumors are extremely vascular, and very commonly pulsate. The excessive development of vessels has led Dr. Jaffé to consider these growths as essentially angiosarcomas. He also holds the view that the cellular elements of the tumor are the offspring of the nuclei of the walls of the vessels.

To the naked eye the section presents a general similarity to the spindle-celled tumors, but is more vascular and more liable to show ecchymotic spots or even cysts or cavities filled with blood. Some degree of ossific deposit occurs in about 17 per cent. Ulceration of skin and fungous protrusion occasionally, but very rarely, occur. Fractures are quite common. They occur in the shafts of the bones, in the proportion of 33 per cent. They are the most rapid in growth and the most steady in progress of any of the sarcomata. They are locally infectious in a higher degree, and more liable to generalization, than either of the other central sarcomata. Infection of glands is very unusual. It may therefore be said that "an immovable, bulky, rapidly growing, painful, soft, pulsating tumor, especially if seated on the shaft of a long bone, occurring at about the twenty-eighth year, and attended with fracture and possibly the protrusion of a fungous mass and enlargement of subcutaneous veins, but without discoloration of the skin, or involvement of lymphatic glands, may be said to be a central round-celled sarcoma."

The second division of sarcomata of the long bones which is made by Dr. Gross, "includes those which originate in the soft osteo-genetic layer of the periosteum in contradistinction to the tumors which are attached to the outer fibrous layer of that membrane; which should rather be considered as periosteal growths, or sarcomata developed in the tissues surrounding the bone, and affecting the periosteum secondarily. In the true peripheral sarcomata the tumor is seated between the bone and the periosteum, the latter of which is constantly regenerating itself to form a limiting capsule for it."

They present three forms, viz., the round-celled, the spindle-celled, and the osteoid.

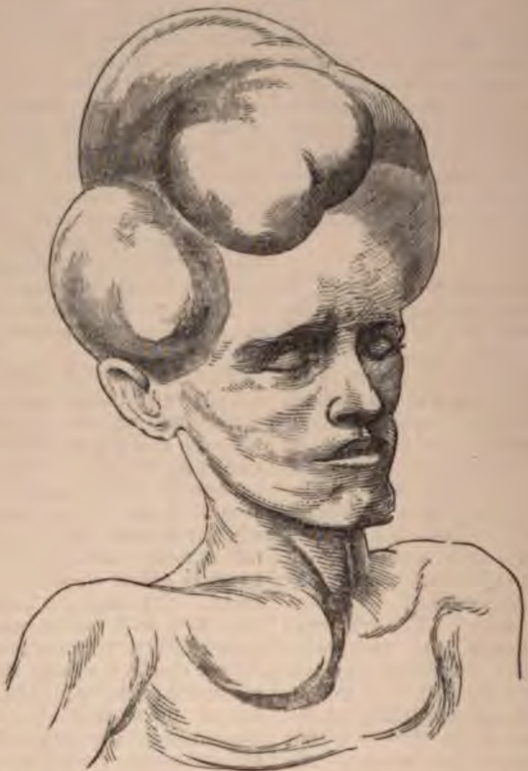
The round-celled sarcoma, in histological elements and arrangement, is identical with the central round-celled tumor already described. Clinically, they occur at a somewhat earlier age, and show malignant tendencies in a larger proportion of cases. The lymphatic glands are often infected; fracture is rare, and pulsation never occurs. The following summary is given of their characteristic features. "A rapidly increasing, painful, lobulated, soft, elastic, non-pulsating, pyriform or fusiform tumor, especially if seated on the shaft of a long bone, occurring at about the twenty-third year, and unaccompanied by fracture, but marked by discoloration of the skin, enlargement of the subcutaneous veins, involvement of the lymphatic glands, and elevation of temperature, may be safely ranked among the periosteal round-celled sarcomata."

2. The spindle-celled periosteal sarcomata occur at a much earlier age. They are most common on the epiphyses rather

than on the shaft of the bone. They very rarely are accompanied with fracture, but are almost uniformly malignant in their tendencies. Dr. Gross thus sums up their diagnostic features: "A firm, slowly growing, painful and non-pulsating tumor occurring at about the twenty-fourth year, and not attended with fracture, lymphatic involvement, or discoloration of the skin, but with possible enlargement of the subcutaneous veins, may be regarded as a spindle-celled periosteal sarcoma."

3. Osteoid Sarcoma. This class has arisen from the fact that a certain number of sarcomata show a remarkable tendency to extensive ossification or calcification, and that the recurrent and metastatic tumors show markedly the same tendency. Paget writes of these tumors as of osteoid cancer, and gives an excellent account of their clinical and microscopical features. Careful study shows that they do not possess the alveolation or, indeed, any of those features which it is now agreed to recognize as cancerous, and that they unequivocally belong among the sarcomata. Microscopically they are distinguished by a well-marked fibrous stroma, in which are found round cells and spindle cells in varying proportion, the fibrous intercellular substance becoming the seat of the calcific change. The ossified fibres usually radiate from the bone surface from which they spring, toward the free surface of the tumors. Sometimes the change is so complete that the whole mass is converted into almost solid bone; but in many cases the course of the original fibres is maintained in the process, so that on maceration the tumor shows a mass of fine spicula, running in various directions, and sometimes interweaving with each other, so as to make a complete framework or skeleton, on which the cellular elements had been supported during life.

Fig. 592.

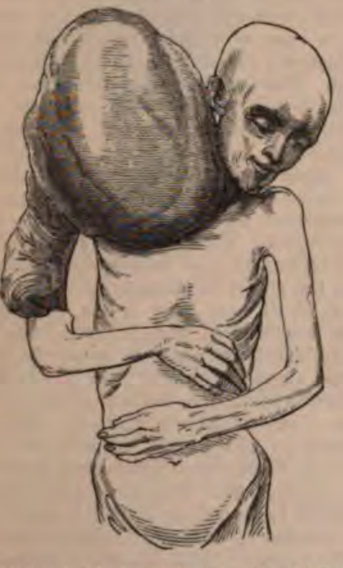


Periosteal osteoid sarcomata. (From a patient in the New York Hospital.)

The osteoid sarcoma is usually found to affect the epiphyses rather than the shafts of the long bones. They rarely pulsate, and do not often ulcerate or fungate. Their growth is apt to be rapid, but the lymphatics are not often affected. They are quite prone to the cartilaginous and myxomatous degenerations. They are apt to infect surrounding tissues, and extremely malignant in their behavior, about 65 per cent. dying with metastatic deposits, whether operated on or not. The clinical features may be given thus: "A hard, rapidly-growing, painful, and non-pulsating tumor, developed at about the twenty-second year, and unaccompanied by fracture, or discoloration of the skin, but attended possibly by enlargement of the superficial veins and lymphatic involvement, may be classed among the osteoid sarcomata."

All these forms of sarcoma, which have been studied by Dr. Gross in the long bones, do occur in other parts of the skeleton, notably in the jaws and cranial bones. In the jaw-bones we have a great many instances of the giant-celled sarcoma, and these often give most satisfactory results, while the small-celled and spindle-celled periosteal tumors are exceedingly apt to be fatal from metastasis. On the bones of the skull it seems probable that the most common form would be periosteal small-celled or osteoid sarcoma, though I have no statistics upon which to base such an opinion. Fig. 592 is taken from a patient who died in the New York Hospital from tumors which were then called encephaloid, but which we would now properly class as periosteal sarcomata. That they were osteoid in character is proved by their containing a very extensive framework of ossific or calcific tissue. The head of fig. 592 was macerated, and gave, as the record says, "the beautiful radiated feathery skeleton of soft friable bone-tissue." This we kept a long time in the museum, but it gradually fell away to a calcific powder. Fig. 593 is taken from a young girl, in whom the tumor attained the gigantic size well shown in the cut in about one year from its first appearance on the clavicle. All of these cases showed metastatic deposit in the lungs, liver, kidneys, and other internal organs.]

Fig. 593.



Periosteal osteoid sarcomata in a girl. (New York Hospital.)

As the general considerations applicable to malignant disease have been described in the essay on CANCER, it will only be necessary here to dwell on the peculiarities which are found in cancer when developed in the bones, with reference to its seat, manner of growth, and external appearances, and to endeavor to deduce the necessary inferences as to diagnosis and treatment.

With respect to its seat, no bone is exempt from the invasion of the disease, but some bones are far more liable than others; the long bones of the lower extremity taking the lead, and the femur being of all others most commonly attacked. Out of forty cases of primary cancer, twelve occurred in the femur, eight in the bones of the leg, five in the skull, three in the pelvis, and three in the spine. The others were single cases scattered about the various regions of the body. The neighborhood of the knee-joint is a very favorite seat of cancer; so that a soft tumor springing from the lower end of the femur or the head of the tibia is always viewed with much anxiety. Out of the above-mentioned twenty cases of cancer of the long bones of the lower limb, eleven are noted to have grown near the knee-joint.

The common kind of cancer in bone presents itself in three principal forms, viz., periosteal, interstitial, and infiltrated. The last is by far the least common. When carried to its extreme degree, the whole bone is softened by the distension of its cells with the material of soft cancer, leading to partial or complete absorption of the cancelli, and general disintegration of the bone. In this condition it forms one of the affections of bone which are included under the name "mollities ossium," under which head it has been referred to above. The periosteal form of cancer appears to be the more common in the long bones, while the interstitial is certainly the one more usually met with in the flat bones, such as the skull and pelvis, and in the joint-ends. The interstitial form is found in the shape of nodules of various, but usually small, size, scattered about the cancellous tissue. They are whitish in color when small and recently deposited, and generally give out a creamy juice under pressure, exhibiting the various cell-forms usually met with in the juice of malignant tumors. In the harder kind of these nodules, following scirrhous cancer in the breast (and to which the designation "scirrhus of the bones," used by some writers, applies, while others call them "hard encephaloid"), I have sometimes been unable to recognize any cancer-juice, or any cell-structure characteristic of cancer.[1] This interstitial deposit of cancer is productive of constant and wearing pain in the part, very frequently followed, in a long bone, by fracture on some slight injury or even muscular exertion. After some time, during which, if fracture has taken place, it may have consolidated, a tumor makes its appearance. The disease, having overcome the resistance of the periosteum, now grows rapidly. On dissection, a large mass of soft cancer is found, in which the periosteal envelope of the tumor may or may not be recognizable, and which springs from the bone by a narrower base, while it generally extends further in the cancellous tissue, or to a still greater extent in the medullary canal. In rarer cases, several separate nodules are found scattered about the cancellous tissue. The bone in the neighborhood of the cancerous deposit is often thickened,[2] sometimes to an extent that can be appreciated by external examination.

The accidental peculiarities of shape and arrangement in the various specimens of interstitial deposit of cancer have given rise to different terms, which having now lost some of their significance, ought to be, and have very generally been, allowed to become obsolete. Thus, when such a deposit in the articular end of a bone grows into a number of cancelli in different directions, the whole of the head of the bone becomes enlarged, forming a sort of multilocular cyst, the spaces of which are filled with the tumor, and the surrounding part of the bone a good deal consolidated. Such a swelling has been called the *malignant exostosis*. In other cases the soft tumor expands the outer layer of the bone uniformly, without producing fracture, and thus a swelling is formed, the wall of which crackles under the finger. This was called a *spina ventosa*.

In the periosteal form, the tumor makes its appearance sooner and grows more rapidly than in the interstitial. The subjacent bone is generally quite unaffected, and a section of the disease shows a ring of healthy bone surrounded by a radiating mass of malignant substance. The periosteum appears in some cases to have degenerated and become converted into the structure of the tumor; in others, it may be traced over the tumor, which then seems to grow between the bone and periosteum.[1] In this form of the disease there is a strong tendency to ossification, so that, after maceration, a large quantity of irregular bony deposit is left on the surface of the bone, forming very often a coral-like mass, with some approach to a spiral arrangement of its laminæ. These specimens were often described by the older writers as periosteal exostoses, their true nature being overlooked in consequence of the bone not having been examined till after maceration.

Cancer in bones is sometimes said to be a less rapidly fatal disease than in the soft parts, and perhaps if we compare it (as would seem most correct) with the average duration of *soft* cancer in the soft parts, this may be so; but the difference is not very marked. In twenty-eight of the cases contained in my notes the disease was followed till the patient's death from its commencement, with such approach to accuracy as is possible in these circumstances. In twelve of them death took place in less than a year (in five in less than half a year) after the first symptoms were noticed by the patient, and ten of the others died within the second year. In two only of the remaining cases was the disease protracted much beyond the usual period of duration of cancer, but neither were cases of encephaloid cancer; one, a case of colloid, might possibly be erroneously classed among malignant diseases. The true encephaloid cancer, then, in the bones, as in other parts, is more rapidly fatal than scirrhus, although its progress in the bone may be somewhat less rapid than elsewhere. But besides the encephaloid, all other forms may in exceptional cases be met with. Some pathologists, indeed, deny the existence of scirrhus in the bones, preferring to class the small hard nodules found in the spine, skull, and long bones, secondarily after scirrhus of the breast, and more rarely after scirrhus of other parts, as "hard encephaloid." The difference in nomenclature is a matter of no importance. Hard cancer, indeed, when deposited in the bones, cannot of course draw to itself the neighboring parts and thus reduce the volume of the organ in which it is placed, so that it is destitute of that puckering so characteristic of scirrhus of the breast. But in other respects it seems identical. The small irregular lump, creaking under the knife, emitting a very scanty juice, and presenting under the microscope, besides a good deal of common fibrous tissue, only small nuclear bodies, and those perhaps in no very large proportion, bears a sufficiently close resemblance to scirrhus in other parts to deserve the same name, more especially when only another product of the selfsame disease. Epithelial cancer attacks bones usually in the course of a cancerous ulceration of the soft parts which cover them, but scattered instances of its occurrence as a primary disease are on record. Thus in the Path. Soc. Transactions, ix., 358, will be found a description of this disease in the base of the skull. It presented the appearance of a mass of fibroid tissue, the meshes of which were filled with a yellow opaque and thick material, which could be squeezed out in the form of comedones, and consisted of a mass of epithelial scales. But these cases are of too rare occurrence to have much of practical importance; nor in the few scattered cases of colloid disease affecting bones with which I am acquainted, is there anything to throw light on the controversy as to the malignant or non-malignant nature of that affection. Melanosis affects bones very rarely, and probably is always a secondary formation; as in the case which has furnished the figure given above. The osteoid cancer has been sufficiently described elsewhere in this work (Vol. I., p. 290).

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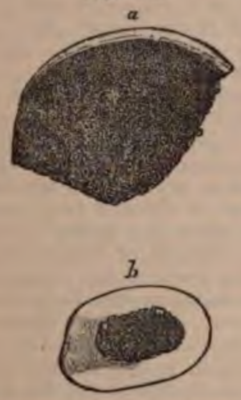
[1] This was so in a case reported in the Path. Soc. Trans., vol. xi., p. 220.

[2] Paget, Surg. Path., vol. ii., p. 362, ed. 1853; Path. Soc. Trans., vol. x., p. 249.

[1] Path. Soc. Trans., vol. i., p. 320.

Fig. 594.



Melanotic cancer infiltrating the cancellous interior of the shafts of the long bones. Sections of the humerus:—*a*. A section taken somewhat parallel to the axis of the bone through its cancellous portion, showing the uniform infiltration of the cells with melanotic matter. *b*. A transverse section. The cortex of the bone is seen to be quite free in this section; but at other parts a few points of melanotic deposit were met with. The preparation was taken from the body of a woman who had been operated upon for the removal of a melanotic tumor. The disease returned in various parts of the body. The whole skin resembled that of a person who had long taken nitrate of silver, and melanotic matter was found both in the rete mucosum and in the derma. There was also extensive deposit in many of the internal organs. From a preparation (Series ii., No. 234) presented to the Museum of St. George's Hospital by Mr. Campbell de Morgan.

In the *diagnosis* of cancer of the bones two difficulties present themselves—*first*, to distinguish between a soft tumor and an abscess or other inflammatory affection; and *second*, to distinguish between a malignant and an innocent tumor.

The diagnosis between a tumor and an abscess is sometimes very difficult. The question occurs only, as far as I have seen, in the neighborhood of a joint; where also the doubt sometimes is, whether the swelling is not due to thickening of the synovial membrane. Generally speaking, however, the soft tumor is limited to one portion of the circumference of the bone, while disease of the synovial membrane would involve the whole circumference, although not necessarily equally prominent over the whole. Further, the chronic thickening of the synovial membrane will have been preceded by a long course of symptoms of disease in the joint, and these symptoms will probably have been more acute at some previous time; while the tumor will have commenced much more recently, at first without any symptoms, and the symptoms will have been more marked as the tumor got larger. Limited abscesses, also, in the thickness of the swelling, are common in the chronic synovial disease, while abscess is a rare complication in the course of a tumor, and then forms external to it and singly.

The following instance of the occurrence of abscess around a rapidly growing tumor, will illustrate the difficulty of the diagnosis in such a case. A young woman was admitted into St. George's Hospital under the care of Mr. Cæsar Hawkins, complaining of pain near the ankle; no diseased appearance then existed. Soon, however, a soft swelling made its appearance, fluctuation was detected, and an incision behind the internal malleolus gave exit to pus mixed with blood, and exposed a cavity which appeared to be that of an ordinary abscess. After a few days arterial hemorrhage came on, and soon became uncontrollable. Pulsation also became evident in the swelling. The incision was extended, and several pieces of soft, breaking down tissue escaped; the finger passed into a mass of fungous matter springing from the os calcis. After amputation the disease was seen to be a soft tumor, about the size of a walnut, connected by a broad base to the calcaneum, and surrounding the posterior tibial vessels. The artery showed a small perforation.

It is seldom, however, that such difficulty is experienced as in this case in forming the diagnosis; and if from the ambiguity of the symptoms, and the thickness or tension of the soft parts over the swelling, doubt is felt as to the presence of a soft solid or a collection of fluid, the introduction of a grooved needle will in most cases decide the question. Usually the lobulated surface of the tumor, and the healthy and uninflamed state of its coverings, suffice to distinguish it from an abscess.

The diagnosis between malignant and innocent tumors is often very difficult, and sometimes impossible. It is of most importance, and unfortunately is also of most difficulty, in those which grow around the lower end of the femur. Malignant and myeloid tumors here often bear the strongest resemblance to each other, so that the diagnosis in an early stage of the cancerous affection can be only conjectural. By a reference to the essay on TUMORS (Vol. I., p. 265) the reader will see that the points to which the surgeon is to direct his chief attention are: the length of time during which the tumor has existed without constitutional or glandular affection, the bulk to which it has attained, and the extent of its attachment to the bone, since myeloid disease is an affection of the cancellous ends, while encephaloid often surrounds the shaft to a considerable extent, forming a long oval tumor, like a great ferule. But it must be allowed that the diagnosis between these forms of disease can hardly be expected to be accurate, inasmuch as there is strong reason for believing that myeloid tumors are occasionally malignant. There are other tumors also which could hardly be distinguished from cancer until a long progress had proved their innocence. Such are the fibro-cystic, to be afterwards mentioned, and such may also be the case sometimes with enchondroma, and with the diffused osseous tumor. It is only, however, in the very early period of osteoid cancer that its malignancy is not a prominent feature. It grows rapidly, extends far along the bone, and soon affects both the constitutional powers and the absorbent system.[1]

In general, malignant tumors of bone may be known by their large size and rapid growth, their soft consistence, the unequal density of different parts, the large veins which ramify over them, the extent of their attachment to the bone, the frequent presence of large sanguineous cysts, the amount of pain by which their growth is attended and often preceded, and the rapid destruction of bone which they occasion. To these local symptoms the general symptoms of the constitutional affection may be superadded.

The treatment of cancer in all parts of the body resolves itself into the question of leaving it alone, or eradicating it. The only method of extirpating malignant disease of any bone, which is at all satisfactory, is by excising the tumor along with the whole thickness, at any rate, of the part of bone from which it springs. To remove the tumor from the surface of a bone, in the uncertainty which must always exist whether cancer has not also affected the interior, would be highly imprudent. Nor is this sufficient; for if the disease can be clearly made out to be cancerous, the whole limb, including the entire bone which is the seat of the disease, ought to be amputated. When the tumor is situated in the leg, this is a matter requiring comparatively little deliberation; the choice only lies between amputation of the leg and of the thigh, and the difference between one stump and another is of slight moment, compared to the risk of a return of malignant disease. But if the tumor affect, as it so commonly does, the lower end of the femur, the question becomes a grave one; since amputation at the hip-joint must be performed if the disease is clearly diagnosed as being cancerous. If there is a reasonable doubt whether the tumor be soft cancer or myeloid, or whether it be hard cancer or diffused bony tumor, undoubtedly the wisest course is to give the patient the benefit of that doubt, and to remove the limb at the lowest level at which the incisions can be carried clear of the tumor. Even if the disease should prove to be cancer, possibly the recurring disease may be in the cicatrix, and amputation of the stump at the hip-joint may prolong life. But so many cases are on record in which what has been supposed to be malignant disease in this part (and which in all the cases was most likely myeloid) has been completely arrested by amputation of the thigh, that it is only right to try the milder operation in cases not evidently cancerous.[1] In the forearm the character of the disease is usually better marked (as far as I have seen), or in dubious cases the alternative is not of much importance; nor in the humerus is the removal of the limb at the shoulder-joint by any means so formidable as in analogous operation on the lower limb.

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[1] Two cases of osteoid cancer of the femur were in the surgical wards of St. George's Hospital about the same time. In one, although the affection was not of long standing (less than a year, I believe), the inguinal glands presented the characteristic bony hardness. In the other, the tumor, which was mixed with encephaloid, was growing rapidly, and contained a large cyst, the tension of which occasioned much pain, relieved by drawing off the fluid. Amputation at the hip was successfully performed by Mr. Tatum; but the disease recurred in the lungs, and proved fatal in about half a year.

[1] See Mr. Gray's paper in Med.-Chir. Trans., vol. xxxix., p. 121.

Hence in the upper limb the rule should be the reverse of that in the femur, viz., that in cases of doubt the entire limb ought to be removed.

What is the benefit of amputation in such cases as these? This is a question very difficult to determine, if the question be limited to the expectation of life. Scattered cases are met with here and there in which a disease apparently malignant has seemed to be checked after amputation; nay, where it has recurred after amputation, and then been checked by amputation higher up;[1] but these are rare exceptions. The disease may be expected to recur, and to prove fatal; and the operation must be defended rather on the grounds of humanity than of scientific indications, as affording relief from present suffering, and the chance of an interval of some months, perhaps even longer, of health, rather than as holding out much prospect of a radical cure of the complaint.

[There is so much that is uncertain in the results of operation in malignant tumors of bone, so much that belongs to the calculation of chances, that it would seem desirable, if possible, to arrive at some general rules which will at least serve as a guide to us in recommending or dissuading from an operation, and in announcing such a prognosis as may have in it at least some elements of probability.

1. It should be borne in mind that, however strongly statistics may indicate a favorable percentage of cures in any given form of bone-tumor, we are not yet in a position to pronounce positively in individual cases. Although our willingness to operate would very properly be determined by our judgment as to the class to which the tumor belongs, yet we are not at liberty to offer a confidence of permanent cure, even in cases we judge to be most promising. Remembering that the percentage of malignant cases varies from 12 to 70 in the different forms, it becomes us to give always a guarded prognosis, and in the bad forms a decidedly unfavorable one.

2. Want of completeness in the operation is a most disastrous feature. In the long bones, happily, we can usually make sure of a total ablation by amputation. In the bones of the face and of the skull, however, we cannot always be certain of the total removal of all diseased structure, and if this fact can be made evident, it militates very strongly against operation. There may be exceptional cases in which partial operation may be justified to secure relief from suffocation, or constant hemorrhage, or blood-poisoning from putrid discharges, but the rule must ever be not to operate where we cannot be sure of removing the whole diseased mass.

3. The operation itself, it must be remembered, involves a certain proportion of deaths, independent of the disease for which it is performed. This proportion varies in the two chief operations which are resorted to in bone-tumors, viz., amputation, and exsection of the jaws. It is not necessary to state here what statistics have pretty distinctly shown as to the mortality after these operations. It is enough to recognize this mortality of the operation itself as an important factor in the decision we arrive at, and in each case the proposed operation must be credited for its share in the risks the patient is about to assume. These three considerations embrace the chief objections to operation on general principles, but on the other hand we may claim—

1. That a certain percentage of those operated on do permanently recover. This percentage, very large in the giant-celled, becomes sadly reduced in the periosteal spindle-celled forms, but taking all cases together, gives such a percentage of recoveries as constitutes a fair warrant for operation in every case when, on other grounds, operation is justifiable.

2. There seems reason to believe that, even where permanent cure is not achieved, some prolongation of life is secured by operation. In carcinoma proper, in other parts than the bones, the prolongation of life by operation has been shown to be considerable. No one has, as far as I know, given full statistical statements on this point as to those patients with bone-tumors who do finally die of the disease, but as far as published statistics do go, they point decidedly to a lengthening of life by operation.

3. When, after removal, the disease returns, and finally destroys the patient, it returns most commonly in the internal organs. That existence is usually more supportable under the fatal progress of internal malignant disease, than it is under the too visible ravages of the external forms, seems to be pretty well ascertained. To say nothing of the fungous ulceration, the alarming hemorrhages, and the wasting discharge, we may easily believe that the frightful deformity of some of these immense growths (fig. 593), the sickening fetor of the discharge, as well as the heart-sickening sight of the flowing blood, all conspire to make a death from external malignant disease too dreadful to be described, while death from the same disease in the liver or lungs would present no features more distressing or more repulsive than from any of the usual fatal diseases of these organs. While, therefore, I would not claim that

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[1] Path. Soc. Trans., vol. vi., p. 291.

this euthanasia ever is a reason for operation, I think it fair to say that when, for other reasons, an operation is justifiable, this also is to be taken into the account as rendering it desirable.

4. If the patient recover from the operation, there is a period of entire freedom from the disease. This may be short or long, but it is perfect while it lasts, and is almost always accompanied by a feeling of confidence on the part of the patient, that it will be permanent. This state of mental elation and hopefulness is in itself a great gain, though it be only temporary, and certainly fits the system better to resist the recurrence of the disease, if recur it must. Mr. Paget well remarks "when they are no longer sensible of their disease, there are few cancerous patients who will not entertain and enjoy the hope of long immunity, though it be most unreasonable and not encouraged."

Acting upon these principles we may advise an operation—

1st. In cases in which the disease can be certainly and entirely removed, as by amputation of a limb or by excection of the maxillæ.

2d. When there is no evidence of secondary deposit in any internal organ, and no general infection of the lymphatic glands.

3d. When true cancerous cachexia has not as yet declared itself.

4th. When the operation itself does not too seriously imperil the life we are aiming to prolong.

5th. When the tumor has been of slow growth from its beginning. Here we have reason to hope that the slowness which has characterized the growth of the tumor, will show itself in the long delay of its reappearance. Very rapidly-growing sarcomata are commonly very rapidly reproduced.

Lastly, our knowledge of the ultimate disposition of a given tumor must be so uncertain, though we may be enabled to arrange it accurately in the class to which its histology entitles it to belong, that it may often happen that we are performing a perfect and permanent cure, when we have only dared to promise a palliation.]

Pulsatile malignant tumor of bone, and osteo-aneurism.—A remarkable feature in malignant tumors of bone is the occasional occurrence of pulsation in them. This pulsation can sometimes be with difficulty distinguished from that of ordinary or sacculated aneurism. The resemblance also which these malignant tumors of bone sometimes bear to the aneurisms by anastomosis is so strong that they have been described as "aneurisms of bone,"[1] and have been believed to consist merely of a dilated vessel or vessels in the interior of an otherwise healthy bone. But it is now admitted that the great majority, at any rate, of these so-called "osteo-aneurisms" were really pulsatile malignant tumors. The resemblance to aneurism by anastomosis is in the highest degree perplexing when the pulsatile tumor occupies a situation where that disease is common, such as the scalp.

A woman applied at St. George's Hospital some years ago on account of a pulsating tumor on the vertex of the head. Mr. Prescott Hewett, under whose care she was placed, came to the conclusion that the disease was a malignant tumor of the skull, and dissuaded her from any operation. Being anxious, however, to have the tumor removed, she consulted another surgeon, who gave it as his opinion that the tumor was an aneurism by anastomosis, and might be extirpated. Mr. Prescott Hewett accordingly sought the advice of his colleagues, and after a careful examination they confirmed him in his original opinion, that the tumor was malignant and had perforated the cranium. He therefore declined to operate; and the woman was placed in another hospital, by the advice of the gentleman whom she had subsequently consulted, and who then attempted to excise the supposed vascular tumor. The original diagnosis, however, turned out to be correct, and it became necessary to give up the operation. Such cases as these show the difficulties which may be experienced in diagnosing the nature of such a tumor in the scalp; but it more frequently occurs that the pulsatile tumor of bone is situated on the course of some large artery,[1] and simulates an ordinary aneurism (see article ANEURISM, Vol. II., p. 339).

The anatomy of these tumors is as follows: they spring from the cancellous interior of the bone, expanding and eroding its external shell, until they burst out, frequently on both sides of the bone at once, forming lobulated masses, which sometimes attain a large size. On section they are seen to be red, of a fleshy consistence, and containing large spaces or cells filled with blood, from the pulsation of which the tumor derives its movements, and which must therefore communicate freely with the main arteries around, though the exact nature of that communication has not yet been demonstrated. The pulsation appears to depend on the resistance of the periosteum, which is often thickened. Hence when the periosteum is penetrated, the pulsation frequently disappears; as that of an aneurism will do when the sac has given way. The microscopical characters of soft cancers can be recognized in the structure forming the walls of the cells. Spicula of bone are often found mixed up with the malignant matter. The tumor frequently affects the large veins in the neighborhood, projecting into them, or even blocking them up; and several such tumors may exist together, or malignant disease of the ordinary encephaloid variety may be found in some other organ of the body (see the case quoted on p. 340, Vol. II).

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[1] See especially a paper by Breschet, "Observations et Réflexions sur les Tumeurs sanguines d'un caractère équivoque, qui paraissent être des anévrismes des artères des os."

[1] Such tumours may, however, form in any bone with copious diploë. In the Edinb. Med. and Surg. Journ., Nov., 1860, p. 452, is an account of one which implicated the basilar process of the occipital bone and the first three cervical vertebræ.

The diagnosis of a pulsatile malignant tumor of bone is very easy in some cases, almost impossible in others. It is easy when the tumor springs from a superficial bone, lies away from the course of any large artery, and has no bruit; and still more so when other malignant tumors or symptoms of malignant disease are present; but where its connection with the bone is obscure by reason of the depth at which its base lies, when a large artery (which is generally the iliac, gluteal, or femoral) lies near its situation, when its pulsation is accompanied by bruit,[1] when the tumor is solitary and the general health unaffected,—it becomes a matter of the utmost difficulty.

Enough, however, has been said on this subject in the essay above referred to.

[Some assistance may be derived from considering the force of the expansion of the tumor at each beat of the heart. If we place the two hands on the opposite sides of a strongly pulsating aneurism, we shall find that not only do the opposed fingers recognize an expansion of the tumor at each contraction of the heart, but this expansion is found to take place with an amount of power which is surprising to those who do not think of its explanation, which is a purely mechanical one.

It is a well known law of hydrostatics, that when a small tube communicates with a large closed cavity containing fluid, the amount of force acting on the walls of that cavity will be estimated by multiplying the amount of pressure exercised by the fluid in the small tube, at its point of communication with the larger cavity, by the number of times the area of the small tube is contained in the area of the walls of the large cavity. Thus, if a tin or leaden tube of one square inch section communicates by a tight joint with a cask whose inner surface comprises five hundred square inches, and both are filled with water, the pressure in the tube will be according to the height at which the water stands in the tube. If we suppose this pressure in the tube to be one pound, then on the inside of the cask will be exerted a pressure of five hundred pounds, which will be proportionally increased for every pound of additional pressure in the tube. In this way a very moderate force exerted through the tube becomes an enormous force on the inner surface of the cask, which can easily be increased so as to burst the strongest barrel that can be made. This is the principle of the hydrostatic press, by which such amazing power can be developed; and it is also the principle by which the pressure of the blood on the inside of the walls of an aneurism may be calculated; due allowance being made for difference of physical conditions. This enormous force of expansive pulsation in an aneurism, which must be carefully distinguished from its extent, explains very satisfactorily the irresistible march of the disease, no barrier, be it ever so unyielding, and no tissue, be it ever so tough, being capable of resisting its relentless progress. It can also be appreciated more or less distinctly in every aneurism by careful examination, and can be relied on, when clearly made out, as very certainly distinguishing the pulsation of an aneurism proper from that of any other tumor.

In a case recently occurring in the New York Hospital of pulsating tumors in the left groin, a careful study of the entire group of symptoms, and of the history of the growth, left a reasonable doubt in all our minds as to whether the swelling was a tumor developing in the iliac bone, or whether it was an aneurism. The pulsation, however, though it was not very extensive, that is to say, did not separate the sides of the mass very widely, yet when firm compression was applied by the hands on each side of the growth, was so strong that I clearly perceived that the hands were thrust apart by a force which was entirely uncontrollable by any muscular power I could bring to bear upon it. This feature clearly and repeatedly made out in my own mind, decided the diagnosis in favor of aneurism, a decision which was amply justified by the perfect cure of the disease by the application of a ligature to the external iliac artery.

This sign has repeatedly proved itself trustworthy in my experience, though of course it must not be too blindly relied on. For example, in a case of unequivocal malignant tumor of the thigh, in the Roosevelt Hospital, the pulsation was so strongly expansile, that I fancied there must be some very large blood space communicating by small orifices with the arteries, but the autopsy did not prove my suspicion to be correct. The sign is most clear in large aneurisms with little or no stratified fibrin or coagula filling up the cavity, and is sometimes very indistinct where the aneurismal sac is very much occupied by solid substance.

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[1] Cruveilhier (Anatomie pathologique, 1856, vol. ii., p. 901) relates a very interesting case in which an encephaloid pulsatile tumor, springing from the bones of the skull, presented so marked a thrill, and a sound so exactly resembling that of arterio-venous aneurism, that he was led into the belief that such was the nature of the tumor, until dissection revealed its true character.

The application of this mechanical principle in studying the pulsation of a tumor will often help us to a correct decision when the character of the pulsation, be it strong or weak, is well marked.

In cases where other tumors exist, or where the symptoms of constitutional cancer are present, no doubt can be felt as to the inefficacy of local treatment; the disease declares its malignancy by the same signs as cancer in other parts of the body, and its prognosis and treatment must be the same. But are there any pulsatile tumors of bone of a different kind, in which the surgeon can hold out a a hope that the excision of the tumor, or its consolidation by chemical agents, or by ligature of the artery which leads to it, will offer a reasonable hope of cure; or must the patient be sentenced to the hard alternative of death or amputation?

In the former edition of this work I expressed a strong doubt of the existence of the disease ordinarily described as "osteo-aneurism," and gave my reasons for pronouncing all the cases which had been published up to that time, insufficient to establish its reality.[1] A more satisfactory example has been published by Dr. Mapother in the Dublin Med. Press, February 4, 1863, p. 105. In this case there was a pulsating tumor of small size situated on the tibia, accompanied by a distinct thrill and slight bruit; but without any indication of disease in other parts of the osseous system or in the body generally. The diseased tissue was destroyed by two applications of the actual cautery, in doing which its vascular nature was clearly testified by the acute hemorrhage. No other morbid tissue was exposed by the opening which was made into the tumor; but there was, of course, no opportunity for anatomical examination. The wound healed perfectly, and I am told by Dr. Mapother that the patient remained in good health two and a half years afterwards.

Again, in the Path. Trans., vol. xix., p. 349, is the account by Mr. Bickersteth of a case where he amputated the leg on account of a pulsating tumor of the tibia, which "felt firm, but was slightly compressible, yielding to deep pressure, and giving a spongy feel to the finger, with an occasional sensation of crackling. The skin was free and sound. No bruit was audible." An incision was made into the tumor, which exposed a surface having all the appearance of malignant disease, and the leg was amputated under the idea that the tumor was cancerous. On examination of the tibia in front, it was found much expanded at its lower end, where a mere shell of bone remained, bending and crackling under the finger. Behind was a large oval tumor, five inches long by three broad, springing from the posterior and outer side of the expanded tibia, and running upwards from the lower end of that bone into the interosseous space, overlapping the fibula, but not connected with it. It had a distinct wall, and was divided into two parts by the tendons of the tibialis posticus and flexor longus digitorum, which ran in a groove or channel in the tumor, through nearly its whole length. The bulk of the tumor was found to consist of innumerable trabecular spaces; the fibrous bands composing which, as well as the walls of the tumor, were derived from the periosteum of the tibia. These spaces were filled with clotted blood. The part of the tumor external to the tibia was formed by two large sacs, filled with clotted blood. All parts of the tumor communicated with each other.[1] There was no admixture of cancerous matter; and the case appeared, both to Mr. Bickersteth and to the committee of the Pathological Society who examined it, to be a perfect example of aneurismal dilatation of the vascular spaces of the bone.

Mr. Bickersteth has had the kindness to inform me that he has seen the patient very lately, and that he remains perfectly well.

We may therefore allow that in some rare cases, pulsation has been noticed in innocent tumors situated on the long bones, and displaying no other recognizable structure except enlarged vessels. It seems also that pulsation has been recognized in a myeloid tumor;[2] and, as these tumors are usually innocent, it would follow that the mere presence of pulsation in a soft tumor of bone is not to be considered as a decisive proof of its malignancy. If, however, we allow these exceptions to the rule that pulsating tumors of bone are malignant, we must still admit that there is no reliable account of any such tumor connected with the skull or pelvis (those favorite seats of the disease) which was otherwise than cancerous.

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[1] Such are Cruveilhier's case, Anat. Path., 1856, vol. ii., p. 901; Lallemand's, prefixed to Breschet's paper above quoted; Dupuytren's, in Leçons orales, vol. iii., p. 232; and I may add Capelletti's, as quoted in the Biennial Retrospect of the New Syd. Soc., for 1865–6, p. 249.

[1] The preparation is preserved in the Museum of the Liverpool School of Medicine.

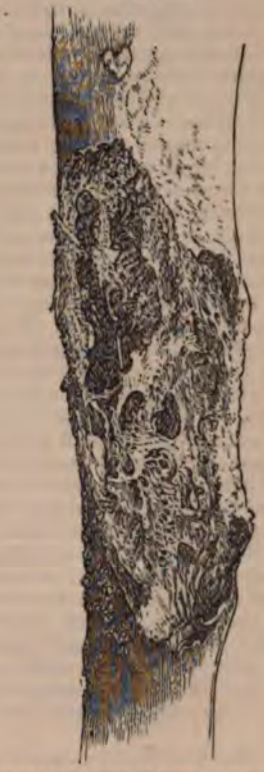
[2] Gray, "On Myeloid Tumors of Bone," Med.-Chir. Trans., vol. xxxix., p. 138.

If such are our views with respect to the nature of the pulsatile tumor of bone, our opinions as to the proper course of treatment cannot be doubtful. To tie a large artery is so very grave a measure, that it can only be justified by the clear prospect of impending fatal hemorrhage, or by the presence of an aneurismal tumor pressing upon important organs. In these pulsatile tumors, however, hemorrhage is rare, and only occurs late in the disease; nor are important parts often pressed upon, except in the cranium. If it be said that the growth of the tumor will be checked by the ligature of its nutrient vessel, the answer is, that this is by no means borne out by experience, and that even if its growth were checked, the disease would not therefore be cured; while the doubtful good to be derived from a very uncertain diminution in the bulk of the tumor is as nothing when compared to the frightful risk of tying a large artery in a subject probably already debilitated by the cancerous cachexia. In many of the recorded cases, the ligature of the main artery appears so far to have affected the tumor as to have checked its pulsation. But the pulsation, though a formidable symptom, is not an essential, and may not even be a constant, part of the disease. Thus Professor Miller relates[1] a case of pulsatile malignant tumor in the ham, which was at first mistaken for aneurism. The pulsation disappeared spontaneously, but returned after an exploratory puncture made in the tumor. Afterwards the pulsation varied, disappearing occasionally, and then recurring.

The purport, then, of all that has been noted as to the course and nature of this disease, and as to the effect of treatment, appears to justify the following conclusions: that in pulsatile tumors connected with the bones of the extremities, if the tumor be small and the other symptoms favorable, the surgeon is justified in treating the disease as an instance of the rare occurrence of osteo-aneurism, and endeavoring to extirpate it either by cutting away the portion of bone from which it springs, or (better) by caustics or the actual cautery; that if it be of large size, amputation should be recommended through or above the nearest joint, except in those connected with the lower end of the femur, where it may occasionally be advisable to amputate near the tumor; that the ligature of the main artery of the limb is unjustifiable; that in pulsatile tumors connected with the head, chest, or pelvis, no local measures ought, as a general rule, to be employed, but the disease should be treated as one of cancer; and finally, that the prognosis may be rendered somewhat less grave by remembering that pulsation has been noted in a myeloid tumor.

Cancerous ulceration is usually preceded by a known and evident tumor, probably epithelial; but in some cases the malignant deposit may have been entirely interstitial, and in others the patient is not seen until extensive ulceration has destroyed any tumor that might have existed. Such cases occur most usually about the bones of the face; and I have seen death produced where the lower jaw was implicated in a case of this kind, by the extension of the ulceration into the lingual artery. During life some difficulty may be experienced in distinguishing this cancerous affection from the rodent or phagedænic ulceration, spoken of at p. 140; but it is a matter of little practical importance, since amputation or complete excision would be recommended in either case, if the patient's general condition admitted of it. The bones of the face are peculiarly liable to extensive destruction in cancroid ulceration and in

Fig. 595.



Malignant ulceration of bone. (Museum of the Royal College of Surgeons, No. 640.)

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[1] Edinb. Med. and Surg. Journal, April, 1860, p. 963.

lupus, but the chronic course of these affections sufficiently distinguishes them from cancer.

In the macerated bone, malignant ulceration produces extensive and irregular destruction both of the compact and cancellous tissue, without any trace of the periosteal and other inflammatory deposit that bounds the more healthy forms of ulceration (see fig. 595).

NON-MALIGNANT TUMORS.

Tumors of bone are like those of soft parts in all important respects. They are innocent or malignant; the former being, for the most part, composed of some of the same structures as form the bone itself, in a more or less perfect state of development (homologous tumors); while the malignant tumors are composed of other structures, to which the osseous tissue in a state of health presents no analogues (heterologous). The parts which compose a bone are fibrous membranes, cartilage, the proper osseous tissue or granular base, and bloodvessels; together with the spaces or cancelli filled with fat, which give the bone the requisite lightness. Now any of these elements over-developed or imperfectly imitated may give rise to a tumor. The overgrowth of the fibrous tissue gives rise to the true fibrous tumor; its imperfect imitation by morbid action produces the various forms of fibroid or fibro-plastic tumor; excessive or misplaced growth of cartilage results in enchondroma; of bone, in exostosis. Whether the vessels of bone are ever simply over-developed, without any other morbid product, so as to form the "osteo-aneurism" spoken of by numerous surgical pathologists, is a question which has been discussed above. From the over-distension of the cellular spaces of bones, some of their cystic tumors probably arise; others are formed by a peculiar arrangement of the connective-tissue in tumors belonging to different classes; and some of the growths, which are classified with cysts, are merely entozoa in the cancellous tissue. Lastly, analogous to the fat and medullary tissue which fills the cavities of the bones, we have a class of tumors, the myeloid, which, since their first description by Mr. Paget, have not ceased to attract much attention, on account of the interesting surgical and pathological questions connected with them.

Enchondroma. — Cartilaginous and bony tumors can hardly be treated of separately, for although the well-marked specimens of either class present little similarity at first sight, some of each are so intimately related, that the two could not without confusion be made the subjects of separate sections.

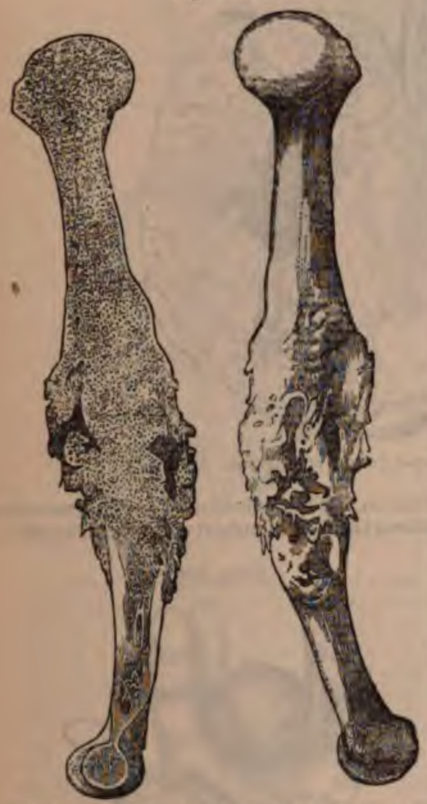
Cartilaginous tumors, or enchondromata, as they are called, have been already described in the essay on TUMORS (Vol. I., p. 261), so that it now only remains to speak of them as they affect the bones.

These formations may be divided, for surgical purposes, into two classes: the circumscribed and the diffused. [This distinction into diffused and circumscribed may, perhaps, lead to misconception, as the cartilaginous material is never diffused through the adjacent tissues in any such sense as are cancerous growths. It is true some of these tumors show a remarkable disposition to push their way in every direction, insinuating themselves into every space or opening to which they can gain access, and thus grow to a great size, perhaps in a region far from their point of origin. Some most interesting cases of this kind, for instance, are recorded, where this intrusive growth of the cartilaginous material has found its way inside of the spinal canal, and caused paralysis from pressure upon the cord. But in all these cases there is a distinct line of condensed areolar tissue limiting the growth, and separating it from the neighboring tissues which are displaced before it, but not infiltrated by it.

This form of cartilaginous tumor is, perhaps, the one that is most apt to assume a malignant behavior by local recurrence, and even, in rare cases, by generalization. In one case, which I saw several times with Dr. Gurdon Buck, he operated several times, at intervals sometimes of years, for recurrent growth, and finally the man died with immense masses of cartilaginous-looking material in some of the splanchnic cavities. No microscopic examination was made. In this case the tumor, growing first on one side of the nucha, involved more and more the deeper layers of muscles on the back of the neck, and, reaching down to the sides of the cervical spine, pushed some of its prolongations into the cavity, as was evidenced by slight but gradually-increasing paralysis. This course was taken by the growth in two recurrences, and in both, after as thorough an extirpation as could be accomplished, the paralysis disappeared.]

The former as a rule do, and the latter do not, show a tendency to ossify throughout their whole extent; although even in the diffused enchondromata the part of the bone from which they spring is often occupied by a considerable osseous deposit, while the bulk of the tumor remains unossified. The diffused enchondromata usually grow as extensive infiltrations into the tissue of the bone and periosteum, and in the course of time spread slowly over the surface of the bone (retaining for the most part their covering of periosteum), and fill all the spaces or cavities in relation with the bone. Such was the case in the instance shown in fig. 596, where the whole medullary canal of the shaft of the humerus is occupied for a considerable extent by porous bone forming the base of a cartilaginous tumor, which surrounded the bone, and had been growing for a long period without much inconvenience to the patient. It is difficult to determine their precise origin, and thus to make sure whether they are new formations, in a strict sense, or outgrowths; but the former opinion seems more generally probable. I have, however, met with one of these tumors, in the phalanx of the finger of a child, where it seemed probable that the origin of the tumor was the epiphyseal cartilage. [Of these tumors, springing from cartilage either epiphyseal or sutural, Virchow makes a class, calling them Ecchondroses. He claims that they present peculiarities in their history which entitle them to this separate consideration. In particular he notices the fact that they are sometimes found springing from the sutural cartilage which in young persons unites the occipital and sphenoid bone, and, projecting down into the cavity of the pharynx, form one variety of the growth which we denominate in general terms naso-pharyngeal polypus. It seems possible that the prognosis in these cases might not be so favorable as in the ordinary fibroma found in this region.] These non-ossifying cartilaginous tumors, or pure enchondromata, are little amenable to surgical treatment, unless in a part favorable for amputation. They have been supposed to present some analogy to malignant diseases, to which, indeed, their extensive diffusion and steady irresistible progress do offer a resemblance. They differ, however, from the true cancers at any rate in one feature, which is quite characteristic, viz., that however extensive their diffusion, they affect the surrounding parts only by pressure or absorption, not by contamination. This is their most distinctive feature; but it is not so useful in diagnosis (since it is less easily appreciated during life) as their rate of growth, which is usually slow. To this rule there are, however, rather frequent exceptions, of which three remarkable instances are related by Mr. Paget,[1] in one of which the rapid growth of the tumor led to the erroneous diagnosis of malignancy, and so deprived the patient of the chance of recovery which amputation would have given him. Remembering these and similar cases, we must not be too confident in inferring malignancy in the case of a tumor of bone from the single fact of rapidity of growth, although that is, doubtless, a most suspicious and unfavorable symptom. In many cases, these large cartilaginous tumors remain stationary for a long period; and this should be taken into consideration when consulting on the propriety of amputation.

Fig. 596.



The humerus in a case of diffused cartilaginous tumor (Museum of St. George's Hospital. Series ii., No. 183.)

The structure of these tumors varies; usually they are quite solid; in other cases cysts, filled with fluid, are found in them, as in the beautiful specimen from which the annexed figure (fig. 597) was taken. They sometimes consist exclusively of cartilage; but more commonly fibrous tissue is to be found, in sparing quantity, in some parts of them. The microscopical appearances will be found described in the essay above referred to (Vol. I., pp. 261, 318).

The circumscribed cartilaginous tumors are, however, much more frequently met with, and are, therefore, more important in practical surgery. They spring almost exclusively from the long bones, the pha-

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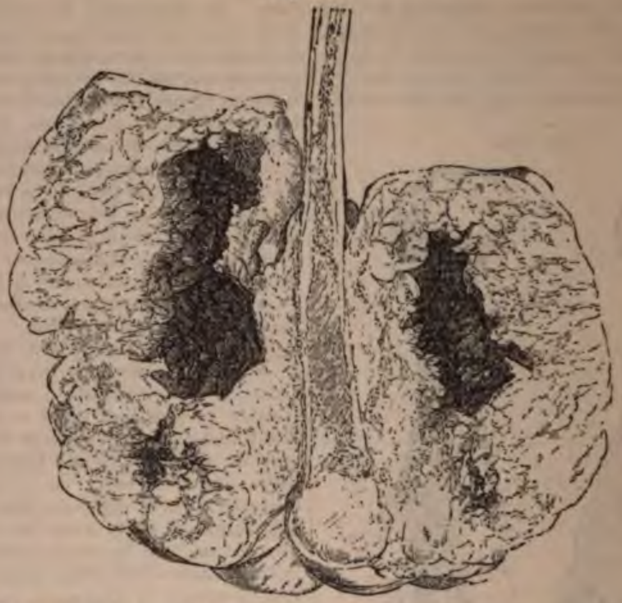
[1] Lectures on Surg. Path., vol. ii., p. 181.

Fig. 597.

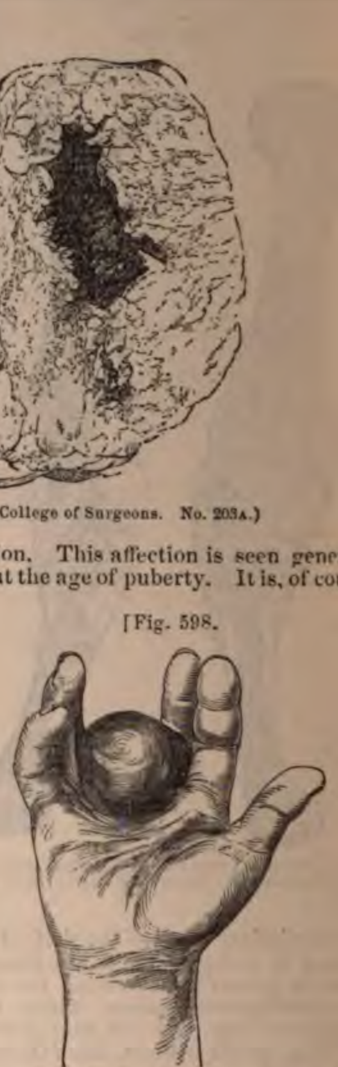


Cystic enchondroma. (Museum of the Royal College of Surgeons. No. 203A.)

langes of the fingers and toes being their most frequent seat. A small enchondroma is comparatively often met with, springing from the end of the last phalanx of the great toe, raising the nail up, and giving a good deal of pain in wearing the boot. It should be cut away from the bone, and usually will not return; should it do so the phalanx must be removed. [The removal of the entire phalanx seriously shortens the toe, and is not necessary. The growth is always from the upper surface of the phalanx and quite near its distal extremity, so that the removal of the anterior part of the bone, just at the sort of neck which supports the terminal enlargement of the phalanx, is entirely sufficient. In making this section of the bone, the entire nail will have to be removed by an incision which goes behind the matrix. If this is not carefully done small portions of the matrix may remain, which may give growth to irregular portions of nail, and become a source of great annoyance to the patient and vexation to the surgeon.]

In the hand and foot, enchondromata are often found in great numbers at the same time; and the appearance thus presented is very characteristic, and is not, as far as I know, imitated by tumors of any other kind. The fingers are studded over with bosses or knobs, looking something like the dry gnarled branches of an old tree. [Fig. 598 shows a solitary enchondroma of a metacarpal bone.] Of this form of disease fig. 599 is a good illustration. This affection is seen generally about the age of puberty. It is, of course, quite incurable, except by amputation; but that measure should never be resorted to in any disease of the hand without evident necessity. In the foot less scruple need be entertained, since the foot, deprived of its anterior portion, is still a very useful member, and there would be no necessity, even in a very advanced case, for going further than Lisfranc's or Chopart's operation. I have never seen a case where anything more was required

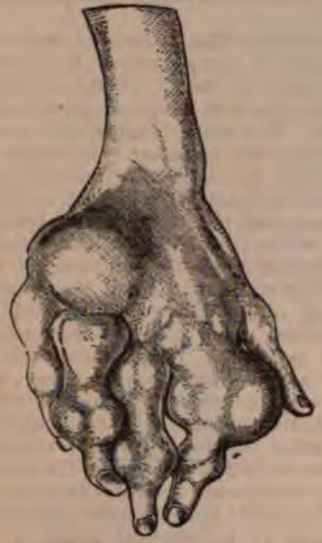
[Fig. 598.



Enchondroma of a metacarpal bone.]

than to remove one or two toes. In the hands, these multiple enchondromata, if left alone, grow generally very slowly, and sometimes not at all. Cases are, however, on record where they seem to have increased slowly during the whole period of life, and to have attained at length a truly extraordinary development. Of this the specimen figured by Müller[1] is an excellent instance; and a very similar case has been described and figured by the writer,[2] where, however, the cartilaginous structure was less distinct. Such tumors usually originate in the interior of a bone, expanding its walls into a thin bony cyst or shell, which is liable to give way at different parts, and firm pressure will then elicit a feeling of crepitation (see fig. 601, on p. 189). [Mr. Stanley states, that when a single tumor occurs on the finger or toe, it is usually found to grow from the outside, but when several fingers or toes are affected with these growths, they commonly originate within the bone.] These multiple enchondromata, like the diffused cartilaginous tumors just described, seem to show little tendency to ossify in the strict sense of the term; but they undergo, when very old, a process of calcareous degeneration, which, added to their general increase in size, produces ulceration of the skin over them; and so a condition is brought about not unlike that of a mass of enormous chalkstones exposed. More rarely the tumors spring from the surface of the bones.[1] [In contrast to this ossific change, a softening is occasionally observed in which the tumor loses its firm, elastic, characteristic consistence, and becomes converted into a soft jelly-like material, which at points becomes almost fluid. This is chiefly seen in old and very large tumors, and doubtless may be regarded as a degeneration.]

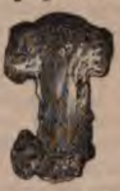
Fig. 599.



Model of a hand affected with numerous enchondromata. (From the Museum of St. George's Hospital.)

Circumscribed and solitary enchondromata usually grow from the surface of a bone, and most of them show a strong tendency to ossify, the process commencing generally at the base. Hence the surgical considerations applicable to them are identical with those which apply to exostosis. When a circumscribed enchondroma grows in the interior of a bone, as in the figure above referred to, it can be readily enucleated, and when a small cartilaginous tumor springs (as it often does) from the end of the last phalanx, usually of the great toe, its removal is very easy, and is always, as far as I

[Fig. 600.



Sub-ungueal exostosis of phalanx of great toe.]

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[1] Ueber den feinern Bau und die Formen der krankhaften Geschwülste. Berlin, 1838, tab. iv., fig. 1.

[2] Path. Soc. Trans., vol. ix., p. 382. The specimen is in the Museum of St. George's Hospital.

[1] With regard to the ordinary seat of cartilaginous tumors of bone, Dr. Pirrie makes the following observations, which I believe to be generally true: "I have now seen in my own experience nine specimens of cartilaginous tumors near the ends of long bones, and they have all been situated between the walls of the bone and the periosteum, and in no instance extended to the cartilage of incrustation at the end of the bone. I have met with fifteen examples in metacarpal bones, and they all originated within the bone, and caused more or less of expansion of the walls and their conversion into a thin crust or shell around the tumor, in various instances at parts completely absorbed. I have seen and carefully examined seven examples of the same kind of growth in the middle of the long bones, and they were all placed within the canal and around the wall of the bone. Judging from my own comparatively limited experience, I would conclude that the favorite site of the first class is around the bone; of the second within it; and of the third, both within and around it."—On Acupressure, p. 107.

have seen, permanently successful. [Fig. 600 shows one of these sub-ungueal exostoses, the surface only of which was cartilaginous, which grew from the side of the end of the last phalanx of the great toe.]

Diagnosis.—The diagnosis of innocent tumors from each other is uncertain and obscure in all parts of the body, and perhaps more so when they are connected with the bones, on account of the generally deep position of the latter. If, however, a tumor presenting the general characters of innocency can be clearly made out to be springing from bone, the chances are very great in favor of its being an enchondroma or an exostosis. If very large, it can hardly be the latter without displaying characteristic hardness. Fibrous and fibroid tumors may be found of large size; still almost all large non-malignant tumors of bone are cartilaginous. Most, also, of the smaller tumors, which do not possess the hardness of exostosis, will be found to be cartilaginous. Such tumors usually possess a certain amount of resilience, and often appear obscurely movable on the bone. This sensation, however, is often deceptive, and due, apparently, to the motion of the soft parts upon the tumor; it has been noticed in tumors, the base of which has been found to be completely ossified, and a slight amount of apparent movement is therefore no conclusive reason for denying the connection of a tumor with the bone. Another thing which ought to be taken into account in diagnosis is, that the cartilaginous, equally with the osseous, tumors may have a bursa over them. This will not often be an obstacle in the way of making out an exostosis, since the hardness of the latter is transmitted through the fluid, but may sometimes cause a doubt about the nature of an enchondroma. The nodulated surface of enchondroma, though characteristic to a certain extent, is far from distinctive of the disease; the same property may belong to colloid disease, fibrous tumor, and other swellings; in fact, the only sensation which affords a reasonable ground for pronouncing a tumor cartilaginous is resilience combined with solidity; and this for deep-seated tumors is often deceptive, and in the many enchondromata enclosed in shells of bone is, of course, absent. On the whole, therefore, an enchondroma is best known by its being an innocent, and not osseous, tumor; elastic when firmly pressed, generally growing slowly, and not affecting the skin. When the phalanges are the seat of the disease, the diagnosis is much more nearly certain. [While the innocence of the cartilaginous tumor is conceded by all, yet the fact must not be overlooked that pure cartilaginous growths have been known to recur after removal, to extend to neighboring regions, and even to become generalized, still preserving both in the recurring and in the metastatic growths their perfect histological composition.]

Exostosis.—The transition from cartilaginous to bony tumors is a natural one, since so many of the former are merely the first stage of growth of the latter. The term "exostosis" is not a very easy one to define. It ought to be used only to signify an innocent tumor, or limited outgrowth, formed exclusively of bone, and not the result of inflammatory action; but, on the one hand, the products of inflammation secreted by the periosteum often assume the form of a limited outgrowth or tumor; while, on the other, many complex malignant tumors possess a bony framework, and, after maceration, bear a great resemblance to exostosis. In the latter case the distinction, though occasionally difficult after the bone has been macerated, is easy during life; so that the mere fact that a malignant tumor possesses a more or less perfect bony framework is of little moment in a practical point of view. Most of the growths which fall under the category of "periosteal exostosis"[1] are extensive inflammatory deposits beneath the periosteum, which neither require nor admit of surgical treatment. Whether limited, pedunculated, and therefore removable, tumors ever occur as a consequence of inflammation is as yet doubtful; but it is highly probable that they do, both from the analogy of the elongated processes sometimes found projecting from the bone in the neighborhood of fractures which have been consolidated with more than the usual amount of inflammation,[2] and also from the following considerations: Exostoses are occasionally found attached to the bone only by a neck composed of fibrous tissue. The occurrence of masses of new bone around the articular ends in the inflammatory disease known as "chronic rheumatic arthritis," and the probability that such masses become subsequently blended with the original bone, is now a familiar fact in pathology.[3] Specimens have been exhibited in which it seemed that inflammatory appearances could be traced around some of the loose exostoses previously referred to;[1] so that it is possible that some exostoses may be developed, as the masses of bone are which form so striking a feature of chronic rheumatic arthritis, in the soft structures near the bone, as a result of inflammation, and may afterwards coalesce with the original bone. The great majority, however, of those bony tumors which are called, in surgical language, exostoses, originate by an outgrowth or limited hypertrophy of analogous parts, just as fatty, fibrous, and other innocent tumors do, quite independent of any inflammatory symptoms. Many authors, especially the French surgeons, speak of "bullous exostoses," meaning apparently by this term those shells of bone which sometimes are formed by the development of a tumor (generally cartilaginous) in the centre of the shaft. Such a case was the one from which the accompanying figure is taken. Another kind of exostosis is that which proceeds from the ossification of tendons, or from the occurrence in man of processes of bone natural to the lower animals. Both of these belong rather to the class of museum curiosities than of subjects of practical interest. Still, if they became objects of treatment, they would probably be indistinguishable from exostoses, and would require the same operation. Few museums are without a specimen of ossification of tendons and other fibrous tissues. Some cases of this kind will be found referred to in the essay on AFFECTIONS OF THE MUSCLES, where also the treatment of persons presenting this tendency is discussed. Such cases as those in which a process projects from the humerus around the brachial artery, when that vessel follows the course usual in the large feline animals, in which it is surrounded by a ring of bone, only need to be known in order to avoid operative interference; and in any operations on bony tumors in regions where such anomalies are known to exist, the nature and history of the case ought to be first carefully investigated.

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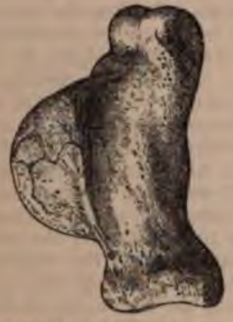
[1] See Gerdy, Maladies des Organes du Mouvement, p. 272; Fano's edition of Vidal (de Cassis), Pathologie Externe, vol. ii., p. 261.

[2] See a preparation in St. George's Hospital Museum, series i., No. 166.

[3] On this head I would especially refer to a paper by Mr. W. Adams, in Path. Soc. Trans., vol. iii., p. 156.

Fig. 601.

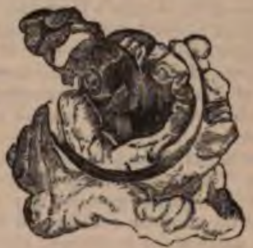


Bullous exostosis on the phalanx of a finger; probably a shell of bone expanded around a cartilaginous tumor. (From a preparation in St. George's Hospital, Series ii., No. 151.)

Excluding these rarer varieties, the cases of circumscribed exostosis which surgeons have to treat are divided into two classes—the cancellous, and the ivory; the former being a reproduction of the tissue of the interior, as the latter is of the hard exterior of the bone. They will be found fully described in the essay on TUMORS (Vol. I., p. 265).

Treatment.—The slow rate at which exostoses progress, and the ease with which the soft parts accommodate themselves to the gradual advance of the tumor, render it frequently unnecessary to meddle with them; and it is always right to defer the operation until it is clearly seen to be necessary; since there is always great risk in operating on any deep-seated tumor, and still greater in laying open the cancelli of bone, as must be done in dividing the neck of an exostosis. Diffuse suppuration in the intermuscular spaces, erysipelas, and pyæmia are very liable to follow such operations. When the exostosis is of the ivory variety, and situated on the cranium, the operation is much more dangerous. Here, indeed, it not unfrequently happens that the tumor is so hard as to resist all the tools which can be brought to bear upon it, so that it is physically impossible to remove it.

Fig. 602.



Ivory exostosis which was trephined unsuccessfully, on account of its great hardness. Exfoliation was afterwards produced by the long-continued application of caustics—chiefly nitric acid. (From the Museum of St. George's Hospital, Series ii., No. 189.)

[The ivory exostosis is sometimes circumscribed, forming a mass, set, as it were, in the midst of bone-tissue otherwise sound, and therefore offering a chance for removal. These cases are most common in the bones of the face, and many successful operations are recorded. Their favorite seat seems to be the neighborhood of the orbit.

A singular fact in the history of such growths is that they are sometimes found detached and lying loose in the cavities of the face and skull bones. Dr. Duka, London Path. Soc. Transactions, vol. xvii., reports a case in which an ivory mass was found loose in the nasal cavity, where it was known to have existed for six years. It was removed by operation, and it is stated that "the whole bony mass weighs one thousand and sixty grains; its long diameter is nearly three inches, the short one an inch and two lines, and the longest circumference seven inches." Mr. Hilton, in Guy's Hosp. Rep., vol. i., gives an instance of a similar tumor, much larger in size, which had existed for twenty-three years, and which, on operation, "fell out of a large cavity in the superior maxillary bone."

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[1] Gay, in Path. Soc. Trans., vol. iv., p. 244.

On the other hand, this form of ivory-like growth is sometimes diffused over considerable portions of bone, seeming more like a localized hypertrophy than a tumor. These growths are characterized by steady, though sometimes very slow, extension, which proceeds in all directions, encroaching upon the cavities of the nose, the orbit, the mouth, the pharynx, and finally, by pressure on the brain, terminating the existence of the long-suffering patient.]

A striking example of this occurred in a case which has furnished a preparation to the Museum of St. George's Hospital. A man, suffering from a small ivory exostosis in the frontal region, fell under the care of the late Mr. Keate, one of the boldest and most skilful operators of his day, who perseveringly, but vainly, endeavored, by the use of trephine, saw, chisel, and mallet, during the space of nearly two hours, to cut off the little lump of hard bone. The patient was fortunate enough to recover from this proceeding; and Mr. Keate, convinced of the uselessness of further operation, determined to attempt the extirpation of the tumor by the free application of potassa fusa and nitric acid to its exposed base. This was successful. The caustics, in the course of years, ate their way through the base of the tumor, which dropped off. The tumor figured in the accompanying illustration (Fig. 602, p. 189) still shows the deep groove worked into it by the trephine at the time of the operation.

It would be rash to say that such operations are unjustifiable, since exostosis in the neighborhood of the orbit may grow into that cavity, or into the cranium, and cause death, or some horrible deformity almost worse than death, by displacement of the eyes, or bones of the face;[1] but the risks of operating on these small exostoses about the cranium should be maturely weighed. Some tumors, however, which present on the surface the character of the true ivory exostosis, may turn out on section to be hard only on the exterior, and to consist of a soft diploic tissue internally. This is the case usually, if not solely, when the bone from which the tumor springs resembles the composition of the vault of the skull, that is to say, consists of diploë covered by a thin table of compact tissue. In bones of which the shell is more dense, such as the lower jaw, it is much more probable that the whole thickness of the tumor will be of compact structure. The exostoses which consist of diploë internally covered by a thin shell of hard substance (and which I venture to think more common than they are usually said to be), are, of course, much more easily removed than the true ivory exostoses which they simulate; and another circumstance which renders the prospect of operations on large exostoses, whether on the skull or other parts, rather more promising than would appear at first sight, is that the tumor when exposed is sometimes found to be connected to the surface of the bone by a very narrow neck, from which it can be easily broken or cut off.[1] [This neck is composed, as is the tumor, of an external compact wall and internal cancellous tissue, a communication taking place through the neck between the cancelli of the tumor and those of the original bone.

Mr. Stanley asserts that this neck does not grow with the tumor, or, at least, not at the same rate. It has been proposed to divide the neck subcutaneously, with the view of checking the further growth of the exostosis. This was suggested by cases of accidental fracture through the neck, which it was found arrested the growth, and occasionally caused shrinking of the bony mass. No very marked result has been reported, and in one case in which Mr. Maunder performed the operation, adhesion of the divided bony surfaces took place, though it is stated that the union left the growth in a better position than it occupied before the operation.

These growths give rise to no symptoms except such as arise from pressure of the encroaching mass on surrounding tissues. These pressure-effects are the usual reasons for operation, and often fully justify it. Some very remarkable instances are cited. Mr. Stanley speaks of an exostosis growing from the posterior surface of the clavicle, which pressed upon the axillary plexus of nerves, and gave rise to very severe suffering on every motion of the limb. In another case an exostosis, springing from the first rib, seriously compressed the subclavian artery. Other cases are recorded where the œsophagus, the bladder, the brain, and the spinal cord have suffered compression from this cause.]

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[1] Some remarkable specimens are in the Museums of St. Bartholomew's Hospital and of the College of Surgeons. Exostoses of the orbit are not always of this dense quality. See a case in Path. Soc. Trans., vol. xi., p. 264, where the tumor was soft, and easily removed.

[1] A most interesting case of a tumor of this kind, growing from the cranium, is reported in the Path. Soc. Trans. for 1850, p. 149, with a drawing, and has been commented on by Mr. Prescott Hewett in his Lectures on Diseases of the Head.

It is, however, only rarely that either the surgeon, or the patient, will make up his mind to the dangerous and doubtful experiment of an operation on an ivory exostosis, especially of the cranium; whereas operations on the more common forms of exostoses which spring from the shafts of the long bones, and present the cancellous, or mixed cartilaginous structure, are of daily occurrence. Their most common situation, after the phalanges, is near the knee, springing from the inner surface of the femur, a little above the condyle. Another very common situation is beneath the deltoid muscle.

The removal of such an exostosis is, in most cases, easy, since the base is not generally very broad, nor the ossification very compact. Some are even so soft as to be divisible with a strong scalpel. A few again are not united to the shaft by bony matter, but by ligamentous union.[1] This condition is highly favorable for operation, not merely because the tumor can be more easily excised, but also because the vascular spaces of the bone will not be laid open in the operation.

In other cases the tumor is broader and more firmly ossified at its base than in any other part; and these are the least favorable cases for operation, since the division of so large a mass of bone requires great and prolonged violence, peculiarly likely to be followed by the complications above enumerated. But the operation is necessary when the tumor is growing, and is threatening the functions of important parts; and in such cases the operator must be prepared for the difficulties which he may have to encounter, and should have a sufficient supply of instruments of adequate strength at hand, such as stout bone-nippers, a chain-saw, other saws of various shapes, chisels, and mallet. In all cases the base of the tumor should be clearly exposed, and separated with care from the parts around, which may require to be held back with retractors. The separation should be commenced from the side where any danger is to be apprehended (*e. g.*, in consequence of the proximity of a vessel or joint), in order to avoid implicating any important part; and then any amount of force necessary must be carefully but firmly applied, the bone being steadied by assistants.[1]

The "bullous exostosis," or central enchondroma contained in a bony cyst, usually requires amputation of the phalanx upon which it is seated.[2] It may, indeed, be sometimes possible to enucleate the growth, and I have seen this done with success; but as a general rule it is hardly worth while to attempt it; since, if the disease be seated in the hand, the necessary disturbance of the tendons would probably render the finger useless; and if in the foot, the certainty of a speedy and complete recovery would outweigh the advantage of preserving a portion of one of the toes.

Diffused bony, or innocent osteoid tumor.—Besides these forms of limited exostoses, a diffused bony tumor is occasionally met with, in which the whole thickness of the bone for some distance is converted into a lobulated mass of spongy bone, which, in a section of such a tumor that I had the opportunity of examining microscopically, presented the usual structure of bone, but with smaller cavities, and an increased deposit of the granular base.

The specimen (in the Museum of St. George's Hospital, series ii., No. 185) is larger than a man's fist, and involves one side of the lower jaw, from the condyle to near the symphysis. Its innocent nature is clearly proved by the fact that it had been growing for five years without any detriment to the general health, and had been partially removed on a previous occasion without any ill consequences from cutting into the interior of the tumor. On the patient coming under the care of Mr. Tatum, the tumor was completely excised, and with success, as the man was seen in perfect health several years afterwards.[1]

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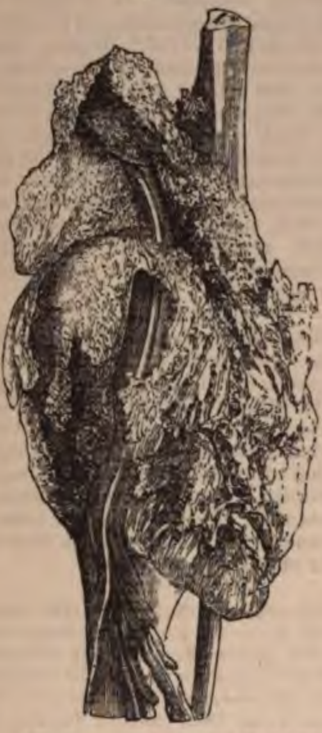
[1] The observations made on pp. 188, 189, and the case of Mr. Gay's patient there referred to, will render it probable that exostoses are sometimes formed in the soft parts around the bone. These, of course, are connected to the bone, at least originally, by ligamentous tissue. Again, ossification of an enchondroma may proceed from without inwards, instead of its more usual course from within outwards. In a third class of cases, exostoses may be movable on the bone as the result of fracture. See a preparation in the Museum of St. Bartholomew's Hospital, series A, No. 183.

[1] It may not, perhaps, be out of place to remark, that in case of an exostosis situated near the knee-joint, there is the more danger of opening the joint, since the presence of the tumor has probably caused numerous attacks of synovitis, which have left the pouch of synovial membrane extending up the thigh permanently enlarged.

[2] I have never seen a tumor of this sort connected with the larger bones; but the statement in the text would apply still more forcibly to such a tumor.

Another still more remarkable case is illustrated by a series of three preparations in the Museum of the College of Surgeons. The history is so interesting that a condensed report of it must be introduced. The thigh was originally amputated on account of a hard and heavy dry osseous substance, surrounding the ends of the femur and tibia, projecting into the knee-joint, extending far up the thigh, and implicating the popliteal artery, vein, and nerve, so as to cause œdema and severe pain (Prep. No. 3244) shown in the accompanying figure. The patient remained well for five years; then another osteoid tumor formed on the stump of the femur, accompanied with severe pain. Amputation was performed higher up. The tumor appeared to grow, not from the bone itself so much as from the periosteum, and enclosed the femoral artery (Prep. No. 3245). There was again an interval of health for two years; then a fresh tumor formed about the stump, continued to increase upwards, out of reach of operation, and finally killed him, from inflammation and sloughing of its soft coverings, *twenty-five years* after the first appearance of the disease. He had been in good general health during the whole time (Prep. No. 3245, A).[1]

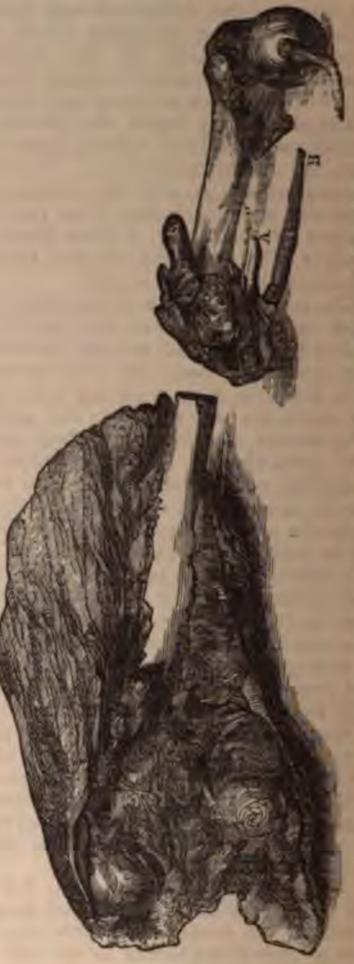
Fig. 603.



Diffused bony tumor of the femur and tibia: the popliteal vessels and nerve are seen surrounded by the bony growth, the veins varicose from the pressure. The tumor overlaps the fibula, which, however, is not affected. (Museum of the Royal College of Surgeons. No. 3244.)

[Fig. 604 shows the femur, as it appears in Dr. W. H. Van Buren's collection, taken from a man with an almost precisely similar history, with the exception that in Dr. Van Buren's case, the disease recurred in the pelvic bones, which were enormously enlarged by a deposit similar to those represented in the cut. All these tumors had an osseous or osteoid character, and were covered mostly by a thin layer of cartilage. This was the view at the time,

Fig. 604



Femur from a case of Dr. Van Buren's; probably a periosteal osteoid sarcoma.

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[1] Path. Soc. Trans., 1848–9, p. 95.

[1] Another, and very similar, case may be found in Mr. Paget's Lectures on Surgical Pathology, vol. ii., p. 506.

but it seems probable that the disease was really an osteoid periosteal sarcoma.]

This history presents a remarkable analogy to that of the recurrent fibroid, or fibro-plastic, tumors of soft parts. There are the same leading features, viz., the local malignity of the disease combined with innocence constitutionally, its imperfect imitation of the tissues in which it grows, its constant recurrence near the site of an operation, and, finally, the mode of death—from exhaustion and sloughing after repeated operations, not from infection of the system.

Cysts in bone are of two kinds; viz., serous and sanguineous. The serous, or mucous, cysts which occur in the jaws as a consequence of irregularity of the growth, or position, of the teeth have been treated of in a former essay. [See Vol. II., p. 571.] In such cases the formation of a cyst containing clear fluid is susceptible of an intelligible explanation; but it is difficult to see how simple serous cysts can be developed in other bones, and probably the few cases which are to be found in books rest upon erroneous diagnosis.[1] But cavities containing clear fluid are formed in bones by the growth of hydatids in their interior; and if simple cysts do occur, they would be indistinguishable from hydatid cysts before operation, and would require the same treatment.

Blood-cysts are not of common occurrence, nor is it usually easy to determine their pathological nature. Many of the cases reported under this title appear to have been examples of malignant tumor, in which a cyst has been developed, much exceeding in relative size the solid portion of the growth.[2]

The most distinct description of a blood-cyst in bone to which I can refer is by Travers, in the Med.-Chir. Trans., vol. xxi. He excised the greater part of the clavicle, on account of a large cystic tumor of about a year's growth, which was very clearly connected with a history of injury. The tumor consisted of an arrangement of cells or chambers, of pretty equal dimensions, filled with dark solid coagula of blood, with spicula of bone in their walls, and invested by a very stout fibrous membrane. "The investing membrane was evidently the condensed periosteum, the cells were the irregularly-expanded cancelli, and the calcareous particles were the débris of the bony plates and walls." Travers is inclined to attribute the disease to expansion of the bony cancelli from blood effused into them as the result of violence. If this explanation be accepted, the affection would be identical with the blood-tumor, or hæmatoma, which is occasionally found in the soft parts as the result of contusion (see Vol. I., p. 385). Mr. Stanley also relates a case[1] in which he amputated the thigh successfully on account of a blood-cyst originating in the condyles of the femur, and where both the femur and the tibia presented "an ecchymosed condition from minute effusions of blood through their compact tissue." This condition existed in the femur up to, if not above, the level of the amputation; yet the disease had not recurred six years afterwards. Mr. Stanley, however, in his description of this tumor, is careful to mention the fact that there were distinct portions of solid matter attached to the inside of the cyst, and would evidently, but for the progress of the case, have been inclined to refer it to the incipient stage of cancer.[2]

Blood-cysts could only be distinguished from serous or hydatid cysts by puncture. In the great majority of cases they would require complete removal, by amputation if necessary. If the surgeon can satisfy himself of the absence of all soft solid matter around the cyst, he may in rare cases be justified in endeavoring to procure its obliteration by laying it open and stuffing it with lint; but it must be borne in mind that such measures can only do harm if there be anything of a malignant taint about the disease.[3]

Fibrous and fibro-cystic tumors.—The great majority of the innocent tumors of bone which are not osseous will be found to be cartilaginous or myeloid; but a smaller number present the fibrous character more or less perfect. Perfect fibrous tumors appear as outgrowths from the periosteum; and the most familiar examples of them are the fibrous polypus of the nose, which is treated of in the essay on DISEASES OF THE NOSE, and epulis, which will be found treated of among the DISEASES CONNECTED WITH THE TEETH. As in other situations, a fibrous tumor could hardly be distinguished from enchondroma before removal, and the diagnosis, even if it could be made, would be quite unimportant. We need not, therefore, give examples of the disease occurring in other parts of the body. Scattered specimens will be found in most of our large museums, and in many of them ossification will be found to have made some progress. In some of these cases the innocent nature of the disease is proved by the history, in others it is an inference from the structure of the tumor. Calcification occurs in these as in other fibrous tumors (St. George's Hospital Museum, ser. ii., No. 152).

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[1] Mr. Stanley (op. cit., p. 194) denies the formation of simple cysts in any other bones than those of the jaw.

[2] See a case reported by Mr. Liston, under the name of "ossified aneurism of the subscapular artery," Ed. Med. and Surg. Journ., vol. xvi., pp. 66, 215.

[1] Op. cit., p. 187.

[2] It is possible that this affection may have been, as Mr. Paget hints, a myeloid tumor, in which the cysts, which are so common in that disease, were developed out of proportion to the solid part (see vol. i., p. 265).

[3] In Nélaton's Path. Chir., vol. ii., p. 48, will be found a striking representation of a large multilocular cystic tumor developed in the femur, and containing bloody fluid. Unfortunately there is no history of this case.

Fibro-cystic tumor of bone is a disease which is little known, and may therefore possibly be of very rare occurrence. It is, however, also possible that this apparent rarity may be due to the fact that most of the examples of this disease have been confounded with malignant tumors. A very interesting account of a growth of this sort connected with the femur, in which the limb was removed at the hip-joint by Mr. J. Adams, will be found in Path. Soc. Trans., vol. v., p. 254, and, appended to the account of this case, a report by Mr. Prescott Hewett on three similar cases, in all of which the femur was the seat of the disease, and in all of which the patient recovered after amputation, and remained well for many years afterwards. There is therefore the strongest reason to believe that the disease was not cancerous. It commenced, in each of the four instances alluded to, in the cancellous tissue of the bone, making its way outwards, infiltrating the shaft, and causing spontaneous fracture; so far, therefore, exactly resembling cancer. It gave the sensation of an elastic substance, with fluid here and there in cavities. There seems to have been no diagnostic mark between it and cancer during life, except the negative indications to be derived from the absence of glandular or constitutional contamination during a somewhat long disease, the duration of the affection being, in the two cases in which that point was noted, three and four years respectively. On examination after removal, the innocent nature of the disease was inferred from the large quantity of firm, glistening fibrous tissue of which nearly the whole solid portion of the tumor was formed, the presence only of such cellular elements as are found in growing fibrous structures, and the absence of cancer-juice, or any other indication of a tendency to disintegration in the tumor, or infiltration of neighboring tissues.

Myeloid tumors, the only other form of innocent tumor which it is necessary to particularize, will be found sufficiently described in Vol. I., p. 264.

Entozoa in bone.—A very few words must suffice for the description of the cases of entozoa in the interior of bone. The entozoon appears to have been the ordinary echinococcus in all cases except one quoted by Mr. Stanley, in which the cysticercus telæ cellulosæ is said to have been found in the interior of one of the phalanges. The subject is of no very great practical importance, since it is seldom possible to diagnose the nature of the affection previous to operation. The cases are so rare, that in the great work of Rokitansky[1] only eight are referred to, as the total number which he supposes to have been then observed. A search, however, through the various pathological collections would probably discover many more than these.[2] It is noticed by Rokitansky,[3] that the disease appears often to be directly induced by some injury; but it is difficult to believe that this can be otherwise than accidental. The disease runs a protracted course, and if the shaft of a long bone be the part affected, fracture, spontaneous or accidental, is very probably the first thing noticed. The fracture, in all probability, does not unite; and it has sometimes happened that in an operation, undertaken for the purpose of resecting the ends of the fracture, the hydatid cavity has been exposed and the globular acephalocysts discharged.[4] Amputation is then indicated in ordinary cases; but one is on record, in which the hydatids were scooped out of the cavity of the cyst, which then filled up, and a complete cure was obtained.[5] In other cases, the seat of the disease is in a flat bone, as the skull,[6] or ilium,[7] or in the expanded head of one or more of the long bones.[8] These cases are quite within the reach of cure when their nature is discovered; and in some rare instances, as in Mr. Coulson's and Mr. Stanley's cases, the discharge of hydatids through a spontaneous opening or a puncture, enables the surgeon to determine the nature of the disease beforehand. Failing this, the symptoms are precisely those of any other cystic tumor of the bone.

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[1] Syd. Soc. Trans., vol. iii., p. 184.

[2] The Museums of Guy's and St. Thomas's Hospitals contain at least five specimens.

[3] Loc. cit. See also the histories of the cases which have furnished the specimens to St. Thomas's Hospital Museum, marked ser. c, Nos. 230, 253.

[4] Dupuytren, Leç. orales, 1839, vol. i., p. 52; St. Thomas's Hospital Museum, ser. c, No. 230.

[5] Mr. Wickham's case, London Medical and Physical Journal, vol. lvii.

[6] Keate, in Med.-Chir. Trans., vol. x., St. Thomas's Hosp. Museum, c. 6^{1}.

[7] Stanley, op. cit., p. 190.

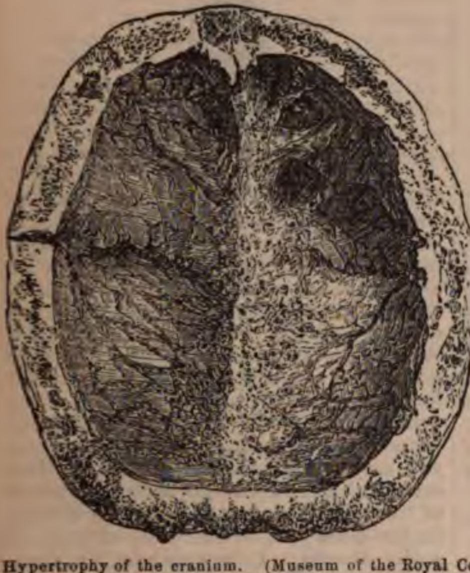
[8] Coulson, in Med.-Chir. Trans., vol. xli. In the specimens in St. Thomas's Hospital Museum, c. 253-4, hydatids were found simultaneously in the lower end of the femur and contiguous head of the tibia. Other cases are noticed in the bodies of the vertebræ. Dupuytren, loc. cit. Guy's Hospital Museum, No. 1029^{30}.

The treatment appears to be usually successful. The cyst is to be freely laid open, with the trephine or bone-nippers if necessary; and all the hydatids removed, and some caustic[1] applied to the whole interior of the cyst. In most of the recorded cases this has been sufficient; but in Mr. Coulson's case the cure was not completed until after the separation of a small piece of bone from the floor of the cavity, which on examination was found thickly studded on both surfaces with a great number of minute hydatids.

HYPERTROPHY AND ATROPHY OF BONE.

The condition of bone usually known by the name of hypertrophy is very generally the consequence of chronic osteitis, and would perhaps be more conveniently designated by some name expressive of its inflammatory origin. Thus, most of the specimens of "hypertrophied cranium" seen in our museums will be found, if the history be known, to be taken from cases of injury, or to be connected with syphilis or scrofula. The cases also of elongation and thickening of the bones of the leg, related by Mr. Stanley[1] under the head of "hypertrophy," appear all of them to fall more naturally under consideration with the sequelæ of inflammation, which have been described above. It appears that this thickening may go on for an indefinite period after the cessation of any symptoms, and that the enlargement of bulk which follows from it is permanent.

Fig. 605.



Hypertrophy of the cranium. (Museum of the Royal College of Surgeons. No. 2858.)

[True hypertrophy, however, does occasionally occur in bone when the actions seem to be those of simple adaptation to changed conditions, as is seen in the heart, when, from valvular disease, increased labor is thrown upon its muscular fibres; those fibres become increased, not merely in size, but in power. They have more work to do, and they gain more power to do it. So in the case from which fig. 606 was taken (see p. 196). It was from a young man who had necrosis of the tibia, with little or no involucrum to supply the loss of bone which had died and been removed by operation. He was, however, able to get about, bearing some weight on the limb, for about eighteen months before his death. It is shown in the specimen, which we have in the Museum of the College of Physicians and Surgeons, that no weight could have been received on the tibia, for a little new bone which has been thrown out is not continuous along the shaft, a small space being ligamentous. The whole weight, therefore, must have been borne by the fibula, which the figure shows has acquired three times the thickness, and probably more than three times the strength, of its fellow of the opposite side.]

It is true that in many of the cases of thickening, whether of the skull or of the long bones, which are preserved in pathological collections, no history of injury or inflammatory affection has been obtained; but the exact resemblance of the specimens to those in which such a history does exist, leaves no doubt that most of them are specimens of chronic inflammation. Cases do, however, occur, though so rarely as to be rather matters of curiosity than of practical interest, in which a bone (the skull for the most part) has gone on increasing in size without any symptoms except those produced by its increase in bulk. Such was the well-known instance related by Mr. Prescott Hewett, in his lectures at the Royal College of Surgeons, in which a man's skull continued to increase in size from year to year, with no symptoms whatever, so that he was only aware of the fact from

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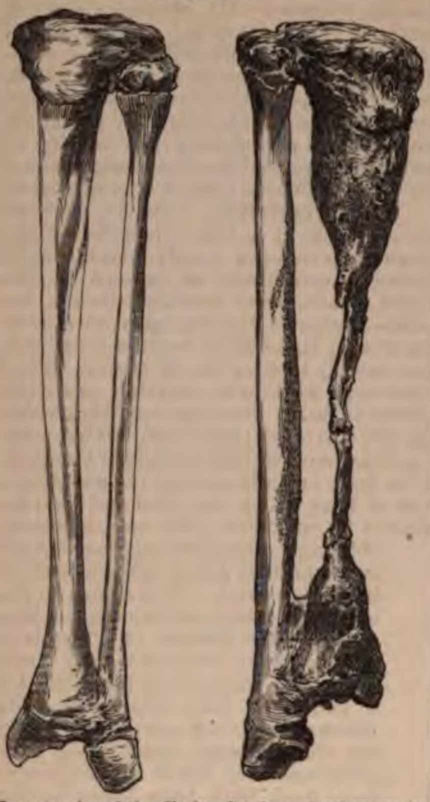
[1] Nitrate of silver, lint impregnated with a saturated solution of sulphate of copper ("blue lint," as it is called at St. George's Hospital), caustic potash, and the actual cautery, have been used.

[1] Op. cit., p. 5.

[Fig. 606.

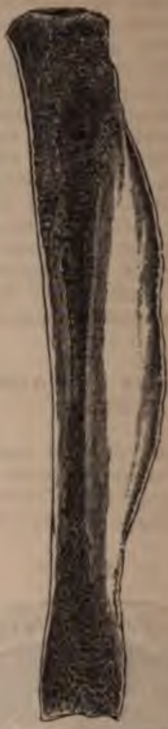


Hypertrophy of the fibula after loss of substance in the tibia by necrosis.]

the increasing size of his hat. The disease, however, in this case was clearly traced to an injury. As no symptoms can be attached to such cases, no treatment is known to have any influence upon them. In the absence of any constitutional affection, the persevering use of counter-irritation, by iodine or blistering, would appear to hold out most hopes of checking the growth. [Fig. 607 shows the condition of hypertrophy with condensation of tissue, often called eburnation.]

Atrophy of bone is a more frequent and a more important disease than the opposite condition of hypertrophy. Inflammation, fatty degeneration, disuse, and injury are frequent causes of atrophy; and there is also a simple atrophy, in which the composition of the bone is unaltered and in which no obvious cause is present (unless it may be the general failure of nutrition in advanced life), and where the amount of bony tissue becomes gradually less and less, until the bone is no longer strong enough to resist slight violence.[1] As a consequence of senile change, or fatty degeneration, atrophy is one of the most common causes of spontaneous fracture. It may also occur in any bone, to some extent, as a consequence of confinement during a lingering disease.[2] Brodie says,[3] "All bones in a state of inaction lose a great part of their phosphate of lime. After compound fracture, when the patient has been long confined, the bones in some instances become as soft as a scrofulous bone, so that you may cut them with a knife." The cases which are spoken of under the name of "fragilitas ossium" appear to belong for the most part to the class of fatty or senile atrophy. Injury sustained in fracture is also a frequent cause of atrophy. Of this, the most extraordinary instance is that quoted by Norris,[4] in which, after two fractures occurring at the same point, near the middle of the humerus, the

[Fig. 607.



Hypertrophy with condensation (eburnation).]

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[1] Humphry, On the Skeleton, p. 8.

[2] See a preparation, No. 384, in the Museum of the Royal College of Surgeons, with its history.

[3] Lect. on Pathology, p. 409.

[4] Amer. Journ. of Med. Sci., Jan., 1842, p. 39.

whole bone disappeared, so as to leave the forearm "swinging hither and thither like a thong," and the arm shortened six inches. It is expressly stated, in the account of this curious case, that there was no open sore, and that the bone disappeared "by the gradual action of the absorbents." Mr. Curling[1] believes that the cause of atrophy after the fracture may often, if not always, be found in injury to the medullary artery. Even allowing, however, that this explanation is plausible in some cases, there are others (not to speak of extreme instances like the one just cited) where it cannot apply. Such are cases of atrophy of both fragments, or of the bone in the neighborhood of the fragments, while the latter are not so much atrophied.[2] Atrophy from inflammation is a condition illustrated by many morbid preparations, though it does not attract much attention in practice. It is merely the persistence of that degenerative change which leads to inflammatory softening; and probably many of the cases of atrophy after fracture should be referred to this head.

Connected with atrophy is the suspension of growth, occasionally, though rarely met with, in which the epiphyses remain separate from the shaft of the bone; and it seems probable that injury to the epiphyseal cartilage, in separations of the epiphysis, may occasionally give rise to shortening of the bone from suspension of growth between the shaft and epiphysis.[3]

Atrophy of bone is an affection which does not appear to be marked by any peculiar symptoms, or to admit of any special treatment. After injury to any part, the restoration of moderate functional activity as soon as it can prudently be recommended, the avoidance of any cause of pressure on the main vessels or those of the surface, and the choice of a suitable posture, with attention to the general health and nutrition, are the objects of a judicious treatment, irrespective of the condition of any particular part; and these measures are all that could be suggested to avert atrophy of the bone, even if it were known to be impending.

Spontaneous fracture has been mentioned repeatedly in the previous pages, in connection with several morbid states, which may be thus enumerated in the order of their presumed frequency as causes of fracture: viz., senile atrophy, malignant disease, tumors of other kinds, including hydatids; the ulceration which accompanies necrosis, and, lastly, other kinds of ulceration. But besides these, cases of spontaneous fracture occur without known cause; sometimes in making a violent muscular effort, as in throwing a stone, or striking a blow; at other times in the most ordinary action, as in turning in bed, quiet walking, etc. Those which are caused by violent muscular efforts too nearly resemble the ordinary cases of fracture (particularly fractures of the patella) to call for any remark here; and the treatment of the fracture in the cases which occur during the progress of known disease is a matter usually of subordinate importance, and has been already sufficiently discussed in treating of the disease. I would merely add, that when the long bones are perforated by ulceration occurring around a sequestrum, the question of amputating the limb, or attempting to save it, will demand much care, and that, as a general rule, amputation will not be required in the upper extremity, nor should it be performed in the spontaneous fracture which rather frequently follows acute necrosis in children, unless the general health is evidently giving way; but in other cases of necrosis of the bones of the lower limb, and in almost all cases of ulceration not due to the separation of a large sequestrum, amputation as a general rule is indicated. When fracture occurs during the ordinary muscular exertion of every-day life,[1] and in persons not known to labor under any disease, various remote causes have been imagined, but none have been proved to be really efficient. The one most commonly admitted is syphilis; but, not to dwell on the fact that the accident has occurred in many persons in whom the strongest reason existed for believing that no such taint was present, all that we know of the action of syphilis on the bones tends to show that (apart from ulceration and the separation of necrosed portions) it renders them not more but less brittle. The practical point of chief interest connected with such cases is, that there is no reason to despair of union, and that they should be treated in the ordinary way, with perhaps more than the ordinary care to avoid constriction of the soft parts.

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[1] Med.-Chir. Trans., vol. xx.

[2] See a preparation in St. Thomas's Hospital Museum, series c, No. 2. Here the atrophy is most marked in the *upper* part of the shaft; and the fragments included between the fractures (which were triple) are thicker than either of the portions of the shaft.

[3] Surgical Treatment of Diseases of Infancy and Childhood, 2d ed., p. 238.

[1] Some interesting cases are to be found in Robert, Conf. de Clinique Chir., 1861; and many are scattered about in various books and periodicals. I remember seeing at St. George's Hospital a stout, florid young man, who had fractured his thigh in simply walking across his room, without catching his foot or making a false step. It healed like any other fracture.

Wounds of Bone.

It is not necessary here to dwell upon wounds of bone, since the reader will find all that is practically important in the essays on Fractures, Gunshot Wounds, and Injuries of the Head. Cases of incised wounds of bone without fracture do, it is true, occasionally come under the notice of the surgeon. The chief interest in such injuries lies in the probability of diffuse suppuration (osteomyelitis) supervening, or of the separation of the periosteum, which is a common event in such cases, leading to necrosis. A reference to those sections will illustrate sufficiently the prognosis and treatment.

ON EXCISION OF BONES AND JOINTS.

By T. Holmes, Esq.

Revised by John H. Packard, M.D.

Excisions in General.

The operations which are to be described in the sequel are all of modern introduction into practice; for although scattered passages are found in the writings of the medical authors of antiquity, which have been held to prove that they were acquainted with the possibility of dissecting out diseased or injured bones, it must be allowed that such passages are in many respects dubious; and it is at any rate certain, that operations of this kind were very rare in olden times; that no rules were laid down for them in ancient surgery; and that they had altogether passed out of notice before the revival of surgery as an art founded on rational principles.[1] When this had once happened, an attempt to preserve a limb by removing only the diseased portions of bone was so reasonable, that it was sure to be made; nor will it now be denied by any one, that a large amount of success has attended that attempt.[2]

I propose here, as well as my limits will permit, to treat, *first*, of the general indications for excision of entire bones or of their articular ends, as opposed to treatment without any operation, or to orthopædic measures, or to amputation; and, *secondly*, to describe the operations in use for removing certain entire bones, and the joints which are accessible to such treatment.

In considering the question between excision and what may be termed the expectant treatment, it may be laid down as a general rule, that a large or important joint ought not to be excised while any reasonable prospect exists of a cure without operation; but when bones which are of no great size, and removable by a moderate operation, are extensively diseased, the surgeon may very reasonably propose to cut short the disease by excising the entire bone, while yet he may allow that recovery is not hopeless should the patient's circumstances allow of his obtaining prolonged and judicious treatment; for the result of prolonged treatment is always doubtful, and the most fortunate termination which could be obtained by many months or perhaps years of care will leave the patient's condition little better than the operation from which he will, in all probability, recover in a few weeks.[1] I have had very frequent opportunities of noting the success of operations for the removal of bones of the tarsus and metatarsus, and the superiority of such treatment to that of waiting for a cure—especially in children, whose restlessness renders confinement less likely to be borne. In the hand and wrist, however, such operations are far less applicable.

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[1] I have not space here to trace the history of excisions from the introduction of the operation by Park and the Moreaus, but would refer the reader for this, and many other points connected with the history and statistics of excision, to a very valuable essay on The Excision of Joints, by Richard M. Hodges, M.D., Boston, U. S., 1861.

[2] Of the success which may attend the practice of excision in properly selected cases, there are some striking instances in the Med.-Chir. Trans. Thus, in vol. lii. of that series, Dr. Humphry reports that he excised the knee in 45 patients, of whom 1 was under treatment, 33 recovered, 2 died, and 9 underwent amputation, of whom 5 recovered and 4 died. Many of these cases were in adults, one being as old as 47. In the same volume Mr. H. Lee contributes a table of 22 cases of excisions of the large joints with only two deaths, both after excision of the knee. Here, however, there was only one patient who recovered from excision of the hip or knee beyond the period of childhood. In vol. liii. Mr. Gant gives an account of 20 cases of various excisions, without a death; 9 of these were excisions of the knee—the eldest 33 years of age—3 underwent amputation; 6 were excisions of the hip—the eldest 26 years of age; the other 5 were cases of excision of the elbow—the eldest 50 years of age. Re-excision was performed in one of the knee and one of the elbow.

M. Sédillot is the chief advocate of an operation to which he has given the name of "l'évidement des os," and which is really nothing else than carrying the usual operation of gouging farther than is commonly done, so as to scrape away the whole interior of the bone, and leave behind (as is presumed) nothing except the periosteum lined by a layer of bone. It must also be presumed that the periosteum and bone so left behind are healthy. I cannot but think that these presumptions are likely to be frequently falsified in practice. If the bone were so extensively diseased as to justify the removal of its entire thickness, I believe either that the periosteum would be easily separable from it, and the whole bone could be removed by subperiosteal resection (as will be detailed further on under the head of excision of the shaft of the tibia), or that the periosteum would also be extensively diseased, in which case the better course would be to excise the whole bone without sparing the periosteum, or to amputate, according to circumstances.

Connected with this part of the subject is the question of the total or partial extirpation of the bone. If the function of the diseased bone be not very important, it is always better to remove the whole of it, since it is often hardly possible in an operation to judge of the real condition of the bone; and if the entire thickness of the bone has to be taken away for any considerable extent, it is very doubtful whether the parts left behind will be of any use; while if the whole be removed, and no osseous tissue be left exposed in the wound, the latter will heal much more readily and probably with less danger of systemic infection.

But the question which far more often perplexes the surgeon is not that between excision and the expectant treatment (except perhaps in the case of the hip), but between excision and amputation. This is so extensive a subject, and so much dependent on the circumstances of each individual case, that I can hardly hope to do more than indicate to the reader the leading considerations which apply to it. They are drawn from numerous circumstances, which may be thus grouped: 1. the situation and functions of the bone or joint to be excised; 2. the state of the patient as to general health, constitutional affection, and age; 3. the nature and extent of the disease; 4. various extraneous circumstances. I will proceed, as briefly as possible, to point out the most common indications for one operation or the other under each of these heads.

1. As to the situation and functions of the bone or joint affected. In the upper extremity, almost any excision which affords a prospect of preserving to the patient the motion of the elbow, of the hand, of the fingers, or perhaps even of the thumb only, is to be preferred to amputation, even although the patient may not recover useful motion in the joint operated on, whether it be the shoulder, or the elbow, or the wrist. There is, however, a limit to the application of this rule, since a limb which swings useless, like a flail, may prove more of an annoyance than an advantage. In the hip the question of amputation for disease does not occur in ordinary circumstances, in any case where excision is possible:[1] and in gunshot injuries, which are almost the only cases in which the operations are pitted against each other, the nearly uniform fatality of primary amputation at the hip, in modern military surgery, gives the surgeon a decided leaning to excision. In the knee the question is more difficult, and the advantages of the stiff limb, left after even the most successful excision, over the artificial substitute (especially in the case of a wealthy person who can afford to purchase the ingenious artificial limbs now manufactured), are not so great as to balance, in the minds of some surgeons, the increased danger to life which (as I fear we cannot help admitting) the operation entails, combined with the risk of failure and of the necessity for consecutive amputation.

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[1] I would also refer the reader, on this head, to Mr. Johnstone's observations in the essay on DISEASES OF THE JOINTS, in the present volume.

[1] In rare cases amputation at the hip-joint is, I think, justifiable, when the disease extends too far for excision, or the knee is simultaneously affected. The point will be discussed further on.

But excision of the knee is now generally adopted in patients otherwise healthy, when the disease is only of limited extent, so as to be curable by the removal of thin slices of the affected bones. In injuries of the knee, excision has not as yet been much practised, nor has the experience obtained of it been very satisfactory: the injuries to the knee that demand operation in civil practice are generally too extensive for excision, and other reasons usually preclude it in military surgery; but in limited injuries it will occasionally be attempted in both civil and military practice. Below the knee, the excision of large portions of the bones of the leg seems much practised in Germany; but chiefly in necrosis, of which we shall have to speak presently. The excision of the ankle has occasionally yielded satisfactory results in the hands of Mr. Hancock[1] and other operators, amongst whom I may reckon myself; but amputation at the ankle-joint is so much less severe an operation, and so much more sure of success, that even now few surgeons care to attempt excision. In cases of injury the comminuted portions of bone may occasionally be removed, and a useful foot preserved; but no rules can be laid down on this point. In the tarsus, the removal of the os calcis when much diseased or extensively injured is a very successful operation, and one which should always be preferred to amputation. The astragalus, when dislocated, has been excised without much impairment to the usefulness of the foot, and I have on several occasions removed the entire bone in chronic disease with a very good result. The bones of the front of the tarsus are far less favorably situated for excision, since they are all enveloped in the folds of a common synovial membrane, and therefore are prone to participate in each other's diseases; but still, in the cases, which are so common, of caries attacking the cuneiform or cuboid bones, an attempt ought always to be made to save the foot, by removing the bones affected, whenever the disease has not spread too far. When one or two metatarsal bones are extensively diseased, they should be dissected out, the toes being removed at the same time, if the operator thinks fit. I have only had occasion to practise this on the first metatarsal bone, which I have several times removed with very good results, leaving the great toe, which will derive so much support from the next toe as to become extremely useful.

2. With respect to the state of the patient, it may be said, in general terms, that excision of large joints is only to be recommended for patients in good health, not worn out by previous disease or confinement, nor deeply affected with constitutional taint (rickets, struma,[1] rheumatism, or syphilis); nor should such an operation be practised in the joints of the lower extremity, on patients past the middle period of life. In the very early period also, many risks may be run with a view of avoiding excision and preserving the limb entirely; and after the failure of such attempts, the case has usually passed beyond the reach of excision, when amputation becomes necessary. So that excisions are almost exclusively practised in childhood, youth, and early manhood.

3. As to the disease—excision is never to be recommended for the removal of malignant diseases of the joint-ends or other parts of the bone. It is true that such operations have been practised by very good surgeons; but they must be regarded as experimental proceedings, justifiable in the early period of the operation, but contra-indicated by more extensive experience. Nor should excision be practised on account of acute abscess of the knee-joint, and only with much caution in acute diseases of any joint. It is much better to endeavor by free incisions and appropriate treatment to support the patient through this stage, with a view of removing the joint (if the extent of the disease renders it practicable) at a later period; but should the patient's health be giving way under the irritation of acute abscess, amputation is indicated in the knee and ankle, and the prospects of excision in other joints are very much less favorable than in chronic cases. The most appropriate cases for the excision of joints are those of chronic disease of all the tissues ("white swelling"), in which the bones are probably not affected to any great depth—a disease which may be due to a strumous taint, but in which the constitutional affection has subsided or is no longer active. In chronic abscess of bone occurring near the articular surface and making its way into the joint, excision may be practised with every chance of success, provided the abscess is not too far from the joint-surface. Necrosis of the articular surface only is another favorable condition for excision; but in many cases the mere removal of the dead bone will suffice. For excision of entire bones, necrosis of their shafts is the most favorable condition, since the periosteal sheath may be relied on to reproduce the bone to a sufficient extent to restore the functions of the member. In such con-

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[1] Barwell On the Joints, p. 463.

[1] I have, however, removed the elbow-joint in strumous children with very good results, though there has been extensive strumous disease elsewhere.

ditions whole bones of the upper and even of the lower extremity have been removed, without any detriment to its ultimate usefulness. In extensive caries, on the other hand, amputation is clearly indicated in the lower extremity; while even in the shoulder, elbow, and wrist, though an attempt to preserve the limb when the carious disease extends considerably beyond the epiphyseal ends may not be unjustifiable, it must be allowed to be of very doubtful benefit.

4. The extraneous circumstances which may decide the surgeon to perform amputation, in a case otherwise favorable for excision, refer principally to the lower extremity, and depend on the facilities for after-treatment. Excisions in the lower limb require, in order to have a fair prospect of success, uninterrupted care and unbroken repose, in appropriate position, from the moment of the operation, for many weeks or even months. Hence the great rarity of the performance of excision of the knee in military practice, and the bad success which has attended it. Or the patient's irritable habits and impatience of confinement may occasionally lead to the preference of amputation.

General Observations on the Operations of Excision.

In the resection of any large joint, except the hip and the shoulder, I prefer in ordinary cases to remove the whole articulating surface. Partial excisions, though they appear to succeed well enough in the two great ball-and-socket joints, are repudiated in the case of the large ginglymoid joints by most surgeons of experience;[1] and even in the hip and shoulder many prefer total excision. Hence it is necessary, in the first place, to divide the soft parts freely, in order to be able to turn the ends of the bones out of the wound, and apply the saw above the articular surface. The removal of the diseased bone piecemeal, by scooping out the joint-ends, is a very inferior practice, for it is difficult to judge of the condition of the part left behind, and the union is liable to be very irregular, and will probably be delayed by the separation of numerous small nodules broken away from the bone, but not removed. Whereas, if the end of the bone be well exposed, and a clean section made with the saw, the condition of the bone left behind can be ascertained with almost entire certainty, and the parts are placed in the most favorable circumstances for union. In the upper extremity, where freedom of motion after the operation is sought for, it is desirable to prevent too extensive cicatrization, and especially the adherence of the cicatrix to the bones. Therefore, when the operation is completed, the parts should be carefully readjusted; those portions of the wound in which it is wished to secure speedy union without puckering should be brought together with silver sutures, while free exit for the matter in other parts of the incision is allowed. It must not be forgotten that excisions are not, under ordinary circumstances, performed until the joint has become disintegrated by chronic disease, so that both the tissues around the joint and those which enter into its composition, vary very much from their natural state. Around the joint, the thickening produced by old inflammation, and the burrowing of abscesses and sinuses, tend to obscure the natural relations and appearances of the parts; while in the joint, old dislocation and partial ankylosis may render what would otherwise be an easy operation inordinately difficult, and may even make it almost impossible to recognize the parts exposed. Then, again, the contraction of the tendons, which sometimes accompanies long-continued disease of the joints, may have reached such a point that the limb cannot be placed in the proper position without the aid of tenotomy. In consequence of all these circumstances, the knife must be kept close to the bones when they are reached, in order to avoid any part which it may be desirable to spare, but which the morbid condition of the tissues prevents the operator from seeing; and the surgeon must be prepared to vary his proceeding slightly with the varying condition of the articulating ends of the bones. The operator should be careful not to confound with caries that roughening of the surface of a bone which is produced by healthy periosteal inflammation, spreading from the diseased joint, and often extending to a considerable distance on all sides of it. Such was the case in the instance here figured [fig. 608] where the section has passed through the roughened portions, but the whole of the carious part has been removed. It is quite unnecessary to remove the parts affected merely with its external inflammation. But the whole of the ulcerated and softened bone-tissue must be carefully eradicated. As to the thickened synovial membrane, which so often lies around the diseased joint-ends, it is well, I think, to cut away as much of it as can be removed without trouble or risk; but I have not observed any harm from leaving small portions of it behind. Before the patient has recovered his consciousness, the limb should, in all cases, be carefully secured upon a splint, in the position it is intended to maintain for the first few days after the operation. This position need not necessarily be the one most favorable for ankylosis, except where bony union is desired. In that case the limb ought never to be moved, if it can be avoided, out of the position in which it is intended to ankylose; and the first dressing, or change of splint, after the operation ought to be delayed as long as due attention to cleanliness allows.

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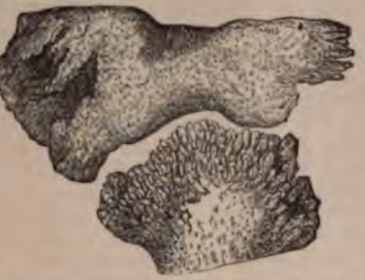
[1] Some very good surgeons, however, occasionally resort to partial excision of the elbow. See, for example, a case of partial excision of the elbow (limited to the head of the ulna) reported by Mr. De Morgan in the Path. Soc. Trans., vol. xix., 323.

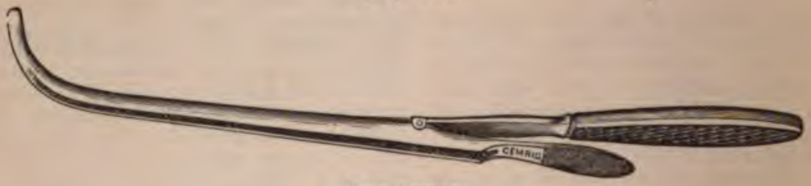
Fig. 608.



Portions of bone removed in an excision of the elbow. From a preparation in the Museum of St. George's Hospital.

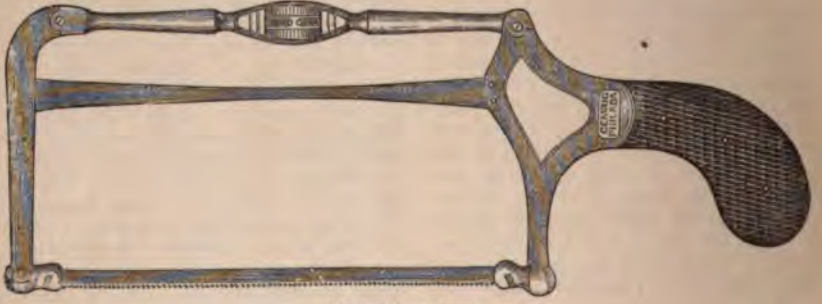
As to the instruments required in excisions, little need be said. These operations are no exception to the general rule, that difficulties are better overcome by the dexterous use of common instruments than by the invention of special and often complicated apparatus. The elaborate instruments described, usually in French surgical works, appear to be really intended to save the surgeon from the necessity of thoroughly exposing the bones, by turning down proper flaps, and thus to enable him to remove the bones piecemeal; and if so, their principle is radically bad. The chain-saw, which seems to be much used in France, is hardly ever employed in England, though it may be useful occasionally in deep-seated parts. Some operators like to steady the bone, and guard the parts around, by passing under it a large director, mounted on a handle; and such an instrument may be very convenient when the bone cannot be turned out of the wound. [(Fig. 609.) This is also of use sometimes in facilitating the application of the chain-saw when that instrument is used.] The saw called by the name of its inventor, Mr. Butcher [fig. 610], will often be found useful, but for ordinary purposes I prefer to use a common amputating saw. The large bone forceps, with a double jaw, called by Sir W. Fergusson "the lion-forceps" [fig. 611], are almost indispensable for holding firmly the piece of bone which is to be sawed off. These instruments, together with cutting pliers, a keyhole-saw, gouge, chisel, trephine, blunt [and cut-

[Fig. 609.



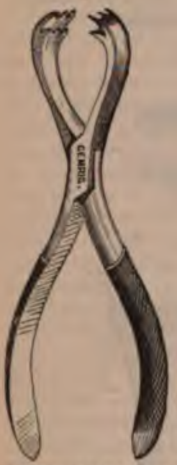
Bone director.

Fig. 610.



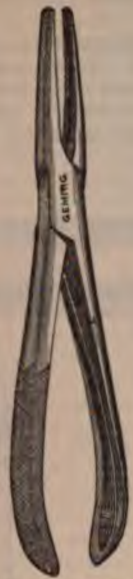
Mr. Butcher's saw.

Fig. 611.



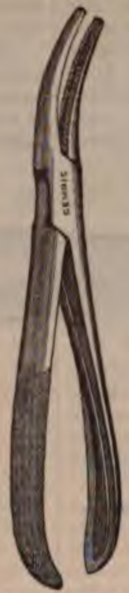
Fergusson's lion-jaw forceps.

Fig. 612.



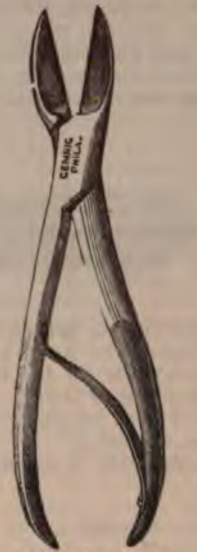
Straight sequestrum forceps.

Fig. 613.



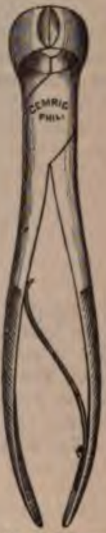
Curved sequestrum forceps.

Fig. 614.



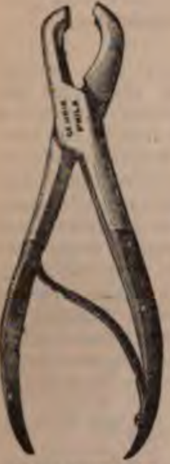
Bone-cutting forceps.

Fig. 615.



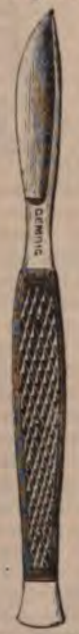
Another form of bone-cutting forceps.

Fig. 616.



Gouge-forceps for removing carious bone.

Fig. 617.



Strong scalpel for bone operations.

Fig. 618.

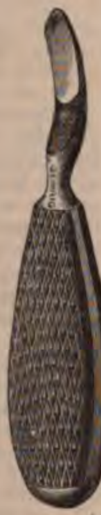


Fig. 619.

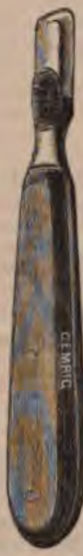
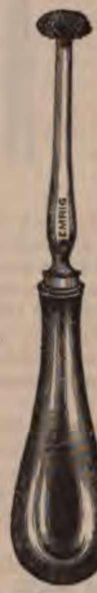
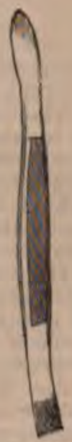


Fig. 620.



Burr for removing carious bone.

Fig. 621.



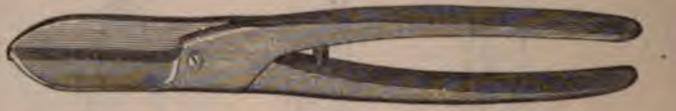
Elevator.

ting] bone forceps [fig. 612], and curved spatulas, are all the special apparatus necessary.

[A strong scalpel, such as is shown in fig. 617, having the end of the handle armed with a blunt steel edge, is often very useful, the latter part being employed to detach the periosteum from the bone to be cut through, or blunt periosteum knives, such as shown in figs. 618 and 619, may be used. Besides the gouge forceps, a burr set in a handle (fig. 620) will serve to rasp away portions of carious bone which could not be otherwise reached. And the ordinary elevator (fig. 621), such as is found in sets of trephining instruments, will be found very useful in prying up sequestra so as to catch them with the forceps.

[Mr. Butcher has also devised a very excellent "knife-bladed cutting forceps," represented in fig. 622. For shearing off small portions or edges of bone, this is sometimes extremely convenient.

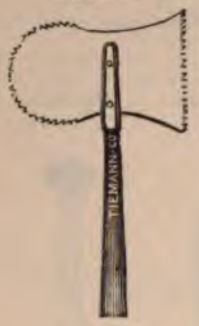
Fig. 622.



Complex instruments are as objectionable in these operations as in all others, but it is worth while for the surgeon to have the best forms of simple tools, and to be provided with suitable appliances for the purposes in hand.

Hey's saw (fig. 623), is sometimes useful in dividing bridges of bone which prevent the ready extraction of sequestra.]

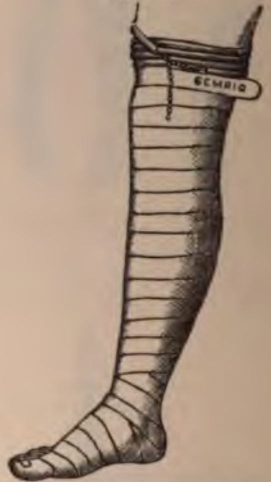
Fig. 623.



The bones to be removed ought always to be taken away as clean as possible, and if, in removing entire bones or portions of their shafts, the periosteum can be left behind, it will no doubt be an advantage, as tending to give more firmness to the cicatrix.

[Esmarch's elastic bandage may often be employed in operating upon the bones of the extremities with advantage. The mode of applying it is by enveloping the limb completely and firmly with successive turns, then encircling it above with a rubber tubing tightly drawn, and removing the bandage itself. The limb will be found bloodless and corpse-like, and can be operated on without hemorrhage. It is said that troublesome secondary bleeding sometimes occurs after the removal of the tubing, but the free use of *very hot* water would probably prevent this. I have never met with anything of the kind.

Fig 624.



Esmarch's bandage applied.]

Subperiosteal Excision. — The general question of subperiosteal resections has lately been brought into much prominence by the labors of M. Ollier, and by the interesting work which he has published on the subject.[1] The operator will find that in many conditions, at any rate, of disease —possibly in most of those in which he is called upon to operate, and in many subjects previously healthy, especially in early life—the periosteum can be stripped off the bone with moderate facility, by using raspatories or chisels with somewhat blunted edges, such as are figured in M. Ollier's work.[2] When this has been done a chain-saw can be insinuated between the detached periosteum and the bone, and the latter removed almost or altogether clean. In amputation of the thigh I have frequently dissected off a sleeve of periosteum from the femur before sawing it through—using this periosteum to cover the section of the stump of the bone; and in many other regions of the body I have convinced myself of the ease with which the periosteum may be entirely separated from the surface of the healthy bone. In many diseased conditions the separation is made still more readily. In fact, in necrosis, and in the advanced stages of caries, the periosteum separates from the bone almost spontaneously. There are other conditions (those in which active inflammation is still in progress, but has not proceeded to suppuration) where the periosteum adheres too closely to the bone to be separated without an amount of tearing and violence fatal to its integrity, and in such conditions the attempt if commenced ought to be abandoned.

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[1] Traité experimental et clinique de la Régénération des Os. Paris, 1867.

[2] I am quite ready to admit, if it is a matter of any moment, that in the former edition of this work I had over-estimated the difficulty of detaching the periosteum in a continuous layer. Subsequent experience in several cases on the living subject has convinced me that this is not only possible, but easy in a great number of cases.

There are various advantages and disadvantages connected with the preservation of the periosteum in excision. The bone will be reproduced to a certain extent at least, and perhaps entirely.[1] This reproduction will give firmness to the cicatrix in case of excision of an entire bone, will fill up the gap and add length to the limb in case of resection of a portion of the entire shaft of a long bone, and will reproduce the articulating portions and the processes for the attachments of muscles around an excised joint. Again, since in the subperiosteal proceeding, the tendons of the muscles are detached entire from the bone, they will not be so much injured as in the ordinary operation, and will probably obtain better leverage. Finally, as the instrument is kept all the time close upon the bone, there is much less risk of injury to the neighboring vessels and nerves. On the other hand, the operative proceeding is long and tedious; it is difficult to remove the bone without detaching the periosteum to some extent from the part left behind; if the periosteum is much handled, it is liable to slough, which delays the healing of the wound and endangers the success of the reparative process; and the reproduction of bone is by no means an undoubted benefit—in many cases is certainly undesirable. Subperiosteal resection, therefore, appears to me inapplicable in several of the special excisions, as will be pointed out in the sequel.

EXCISIONS IN PARTICULAR.

Excision of the shoulder, as the term is ordinarily used, is intended to signify merely the removal of the head of the humerus. The operation is practised in preference to amputation at the shoulder-joint in cases of gunshot wound or compound dislocation, when the injury is not too extensive; and is the only operation admissible in chronic disease of the joint. But in cases of rapidly growing tumor of the head of the bone, amputation would seem the more prudent course; and still more so, if the tumor were known to be cancerous. In ankylosis—an affection which is rare in the shoulder—no cutting operation is justifiable.

[Subcutaneous osteotomy, after the method of Mr. W. Adams, has been done with an excellent result by Dr. J. E. Mears, of Philadelphia, in a case of anchylosis after dislocation. (Trans. Coll. of Phys. of Phila., N. S., vol. iii., p. 199.)]

The head of the bone may be removed, if there is not much thickening over the joint, by a single incision running downwards as far as may be judged necessary from the upper part of the acromion process, over the most prominent part of the head, where it is most plainly felt beneath the skin. This line of incision corresponds pretty nearly to the direction of the long tendon of the biceps muscle. In some cases it is necessary to make a flap out of the deltoid muscle, of a somewhat triangular shape, with its base upwards. The precise position of the incisions which bound this flap is a matter of secondary importance, and is usually determined by that of the sinuses or wounds. The head of the bone, having thus been exposed, is to be rotated (when the shaft is entire) first outwards, in order to stretch the tendon of the subscapularis, then inwards, to make tense those attached to the greater tuberosity; these tendons are to be divided, and the capsule thus freely opened, and then the head of the bone is to be thrust out of the wound, and sawn off. If the case is one of injury, and the head of the bone is severed from the shaft, it must be seized with the lion forceps, and dissected out. The bleeding is usually free, from the posterior circumflex artery or its branches. If the long tendon of the biceps can be distinguished, it should be spared. In both disease and injury, the glenoid cavity often escapes; but if it should be found affected, it may be thought necessary to remove it. This is best done with a large chisel, or with bone-nippers of appropriate shape. The parts should be lightly put together by means of a few sutures, and the patient confined to bed for the first few days, until the consecutive fever has passed over. He may then be allowed to move about, the elbow being carefully supported. The tendency of the muscles, which form the flaps of the axilla, to displace the bone may be counteracted by a pad in the armpit.

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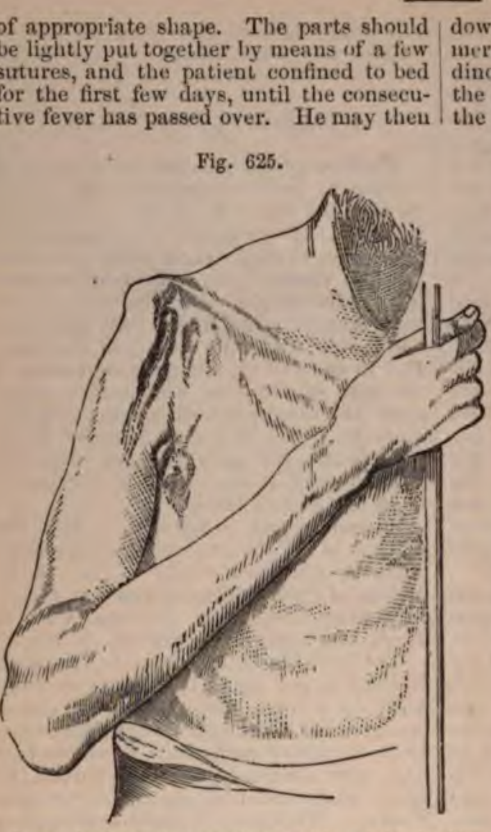
[1] One of the most striking instances of this reproduction is found in the account by M. Doutrelepont of the dissection of a specimen of subperiosteal excision of the elbow, which will be referred to under the head of Excision of the Elbow.

Fig. 625.



Drawn from a patient on whom excision of the shoulder-joint had been performed with success many years previously; to show the position of the wound, the shape of the shoulder, and the atrophy of the deltoid and of the upper arm generally

M. Ollier believes that the sub-periosteal method is even more applicable in the resection of the head and upper part of the humerus than in any other excision, and has given a very interesting instance of its successful performance in a case where, besides the head of the humerus, more than four inches of the shaft were removed.[1] The resulting shortening did not exceed half an inch. The sub-periosteal excision of the shoulder is not so difficult as some of the other similar operations. An incision being made in a somewhat longitudinal direction through the anterior part of the deltoid muscle[2] down to the bone, the head of the humerus is fairly exposed, and all the tendinous and fibrous structures (including the periosteum, the tendons attached to the greater and lesser tuberosities, and the capsule of the joint), are gradually separated from the bone by the sharp and blunt raspatories. The bone can then be pushed out of the wound, and if it is to be divided lower down the operator proceeds to denude it to any required extent by pushing it upwards out of its periosteal sheath until the saw can be applied. M. Ollier has now practised this operation four times, and in all cases with success, removing two and a half inches of the shaft in one instance, and more than four inches in the case above referred to.[1]

The amount of bone which may be removed in cases of injury, with a prospect of preserving a useful limb, appears to be considerable. Four or five inches of the bone have been removed with good result.[2] But no doubt the less that can be taken away the better. In cases of injury, provided all the comminuted portion is removed, fractures or fissures running down from the chief seat of injury may be disregarded. In chronic disease of the joint, the affection is usually limited to the head, except in cases of necrosis; but in necrosis it is more usual to find the shaft only diseased, and the joint exempt.[3]

The amount of motion obtained after the most successful resection of the head of the humerus does not seem so great as that which is recovered in some cases of ankylosis after disease. The arm can never, as it seems, be elevated beyond the horizontal line; while in many cases it hangs

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[1] Case of Louise Gaillard, op. cit., vol. ii., pp. 46 and 514.

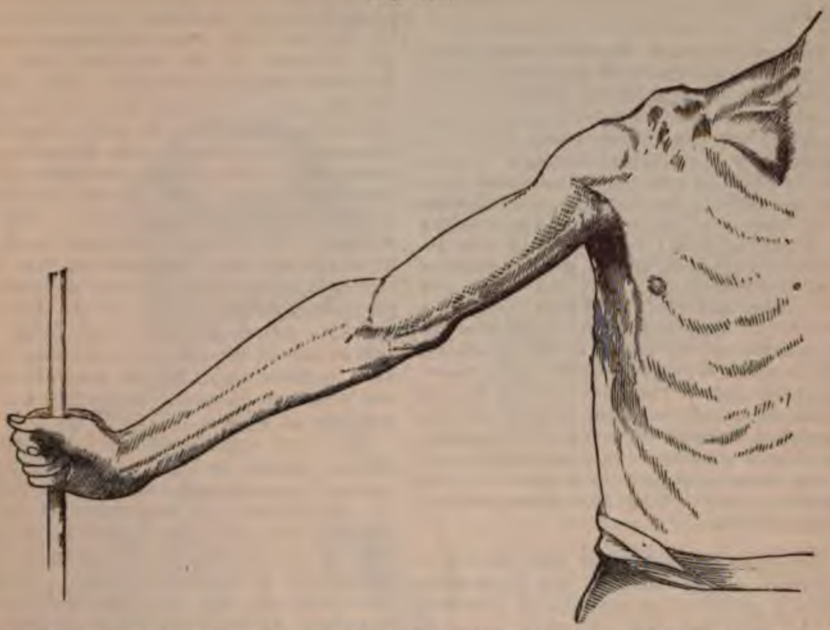
[2] M. Ollier attaches much importance to the preservation of the major part of the deltoid in connection with its nerve—the circumflex. For this purpose it would be desirable to make the incision between the deltoid and pectoralis major, but for the wound of the cephalic vein which this would involve. It is in order to avoid this injury that M. Ollier sacrifices a small part of the deltoid muscle. Other operators, as Nélaton, recommend a transverse incision.

[1] Des Resections des grandes Articulations. Lyon, 1869, p. 15.

[2] Hodges, op. cit., p. 26; Ollier, sup. cit.

[3] In the celebrated case of White of Manchester, usually quoted as the first in which excision of the shoulder was performed, a large sequestrum was removed; but it does not appear that that sequestrum involved the joint; in fact, the plate in White's Cases in Surgery, fig. i., p. 68, clearly shows that the shaft had separated from the epiphysis, and that the part removed was the necrosed upper portion of the diaphysis.

Fig. 626.

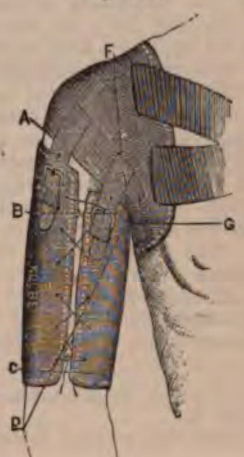


From the same patient as fig. 625, to show the extent of motion obtained. It will be observed that the deltoid, though atrophied, has not entirely lost power.

down, without any power whatever in the deltoid, at a greater or less distance from the scapula. But the movements of flexion, extension, and adduction are usually free; abduction can often be effected to the extent of raising the arm considerably from the side; and there is usually sufficient power in the forearm to carry heavy weights, and perform many of the ordinary domestic tasks. This was the case in the patient from whom figs. 625–6 were drawn. The arm is therefore a very useful one, irrespective of the vast importance of preserving the hand; and the patient is enabled to follow many of the ordinary trades. It does not appear that any advantage is gained by removing the glenoid cavity; while, as far as can be judged,[1] the operation is rendered more severe and more dangerous to life. Hence, unless disease is clearly present in that part, it should be let alone. "The average length of time," says Dr. Hodges, "before some use of the limb was commenced, as calculated from thirty-one of the cases in my table, was over four months; a much longer period than this was required, however, to elapse before the limb could be said to become really serviceable." The table in Dr. Hodges' treatise contains fifty cases, eight of which died, and in four others the operation was unsuccessful.

[Prothetic apparatus, such as is shown in fig. 627, may be employed to great advantage in increasing the usefulness of the arm after excisions of the head of

Fig. 627.



Prothetic apparatus for cases in which a portion of the humerus has been removed. (The letters refer to points for measurement.)]

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[1] See the cases quoted by Dr. Hodges, op. cit., p. 34. Of the fatal cases there reported (eight in number), there was but a single instance of death where the glenoid cavity had not been interfered with.

the humerus, or of the bone in its continuity.]

The results which M. Ollier obtained by the sub-periosteal method in the only case of excision of the head of the humerus alone which he records, though very good, are not markedly superior to those which have been obtained by the ordinary method.[1] In the case in which he removed the head and about half the shaft of the humerus, the following is his account of the result. "The shoulder is of rounded form; not only is the bone reproduced in length, but the scapulo-humeral joint is reconstituted. The end of the new bone articulates with the glenoid cavity by a joint of the enarthrodial type—that is to say one capable of movement in all directions. All the muscles of the shoulder have recovered their action. The deltoid, which in most of the old operations remained atrophied and paralyzed, is capable of energetic contraction. The rotator muscles are inserted on to the end of the reproduced bone, by means of the old capsule, with which they have preserved their former relations."[2]

Excision of the scapula and clavicle.—Excision of the scapula has been occasionally practised on account of necrosis, or the bone has been removed, together with a tumor growing from it: the excision, however, in the latter class of cases has usually been only partial, *i. e.*, only the portion of the bone implicated in the tumor has been removed. The operation in such cases has usually been protracted and bloody;[3] and it may be added that in most of the published cases it was of very doubtful benefit; the tumor being either of a malignant nature, and returning in spite of the operation, which did not seem to prolong life; or else being dependent on syphilis, and very probably curable without any operation at all.[4] These considerations—added to the great severity of the operation in cases of rapidly-growing tumor, where the large arteries which surround the scapula on all sides are enlarged for the supply of the new growth—ought to make the surgeon very cautious in recommending such operations. The operations on the scapula for necrosis, like all other operations for this affection, have turned out much more satisfactorily; but they bear more resemblance to the usual proceedings for the extraction of sequestra than to formal operations for excision. A case related by the late Mr. Jones, of Jersey, in the 42d volume of the Medico-Chirurgical Transactions, will illustrate these observations, and will show what useful motion may be preserved even after the removal of a sequestrum involving almost the whole scapula, inclusive of its articular surface. No special directions are needed for these operations. The position of the sinuses will point out the most convenient directions for the incisions, which should be kept as much as possible upon the limits of the bone, in order to avoid as many of the large vessels as can be spared. The bleeding, however, in these operations for necrosis seems far less than in those performed for the removal of tumors.

The total excision of the scapula for a tumor should be thus performed. The patient being brought under the influence of chloroform, an assistant should be charged with the compression of the subclavian artery; for which purpose, if the projection of the tumor makes compression difficult, the incisions may be so managed as to enable him to put his finger directly down upon it. This precaution much diminishes the hemorrhage from the subscapular artery and its branches, which otherwise might be formidable. The surgeon then proceeds to denude the tumor of its outer coverings by turning down appropriate skin-flaps, taking great care, however, not to open the capsule of the tumor itself.[1] When the whole tumor is thus exposed, the muscles inserted into the vertebral border of the bone should be rapidly divided, as also those which are attached to the spine of the scapula. The tumor being now movable should be lifted well up, and freed from its other attachments by rapid strokes of the knife, commencing from its *lower* angle. The subscapular artery is divided near the end of the operation, and can be caught hold of by the surgeon or his assistant, and held till the tumor is removed, or can be at once tied. The ligaments of the shoulder are then easily divided and the mass removed.

The acromion process, if not diseased, may be divided with bone-nippers, and left behind to preserve the shape of the parts and protect the head of the humerus.

In this way I have seen the scapula removed with a very large and vascular tumor, without any serious bleeding.

Mr. Syme appears to have been the first surgeon who attempted and successfully performed this severe operation,[1] in the year 1856. The published cases, as far as I know, are twelve in number, five of which have died.[1]

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[1] Case of Hinon, Régénération des Os, vol. ii., pp. 326, 514.

[2] Resections des grandes Articulations, p. 16.

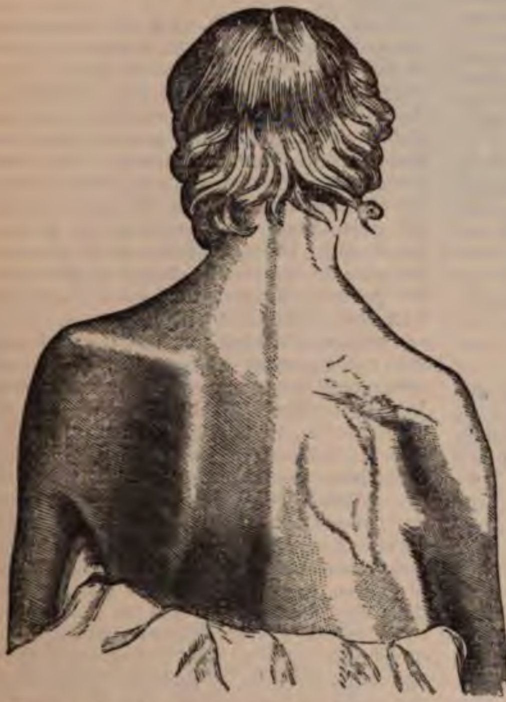
[3] See the account by Mr. Liston of such an operation performed for a tumor which he regarded as an ossified aneurism of the subscapular artery; but which was in all probability a malignant tumor of the bone. Edin. Med. and Surg. Journ., vol. xvi., pp. 66, 215.

[4] Path. Soc. Trans., vol. vii., p. 346.

[1] See Pollock in St. George's Hospital Reports, vol. iv., p. 237.

[2] On Excision of the Scapula, 1864.

Fig. 628.



Drawing from the photograph of a patient on whom excision of the scapula had been successfully performed by Mr. Pollock. (From St. George's Hospital Reports, Vol. IV.)

The resulting deformity is very slight, especially if the acromion has been left behind to preserve the shape of the shoulder, as was done in the case from which Fig. 628 was drawn. The patient was under Mr. Pollock's care at St. George's Hospital.

Almost the same general observations will apply to the excision of the clavicle as to that of the scapula—only, as the relations of the clavicle are far more important than those of the scapula, so must even greater caution be exercised in undertaking its removal. It is not only that very large vessels lie in the neighborhood, which it may be difficult to avoid during the removal of a large tumor passing into the root of the neck, and perhaps lapping over them; but also that the removal of such a tumor from below the deep fascia of the neck involves alarming risk of death from diffuse inflammation. The benefit to be derived from such an operation ought therefore to be most clearly proved before its dangers are encountered.[1] In operations for necrosis the proceeding will be far more simple, and is likely to be far more successful. The sequestrum will probably be separated from the subclavian vein and the deeper parts by a deposit of new bone, and the patient will have a fair chance of permanent recovery. In operating on the clavicle for a tumor, the incisions should be made very free, one over the long axis of the bone, joined by others in appropriate places for turning down such flaps as may appear necessary, and the parts to be operated on should be brought fairly into view before the bone is meddled with. After having freely divided all the superficial attachments of the bone and tumor, the next step is to divide the outer end of the clavicle from the scapula, either by cutting through the joint or by severing the bone with a small saw or nippers. Then the part which is to be removed can be raised, and must be separated with great care from the important parts which lie below it, so as to reach the sternal part, which is the last divided, and which serves during the operation as a pivot on which the bone can be moved and supported; or, in other cases, it may be found more convenient to divide this part of the bone also at an earlier period of the operation.[2] It appears that very useful motion may be recovered after the removal of a large part, or even the whole, of the shaft of the clavicle.

After amputation at the shoulder-joint, the scapula has been extirpated for recurring disease, and portions of the clavicle have been simultaneously removed. One case is on record in which Mussey, of Cincinnati, removed the whole clavicle and scapula for a tumor recurring after amputation at the shoulder-joint.[3] The patient survived the operation, and was heard of in perfect health thirty-four years afterwards at the age of seventy-one.[1] No directions can be required for the performance of an operation which must vary in its steps according to the condition of the parts left behind after the amputation. Mussey commenced from the inner side, so as to expose and tie the subclavian artery early in the operation; and this would probably be the best course if the state of parts should allow of it. He nearly lost his patient from the passage of air into the subclavian vein.

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[1] Ten cases are referred to in the New York Med. Journ., 1866, and in the New Syd. Society's Biennial Retrospect for 1865–6, p. 220. Three of these died. Another case is related in Mr. Pollock's paper in the volume of the St. George's Hospital Reports, and one under Mr. Sydney Jones's care in the Lancet for Nov. 21, 1866. Both of these latter proved fatal.

[1] In Mott's case the operation lasted *four hours*, and thirty vessels were tied. Mott says, "This operation far surpassed in tediousness, difficulty, and danger, anything which I have ever witnessed or performed."

[2] See Travers, in Med.-Chir. Trans., vol. xxi.

[3] Am. Jour. of Med. Sci., vol. xxi.

Excision of the elbow for disease may be thus performed. The bones are exposed by a free vertical incision, running parallel and a little external to the ulnar nerve, about four inches in length, having its centre opposite the tip of the olecranon. This suffices for all ordinary cases. If more room is required, the vertical incision may be crossed by one running outwards from its centre. I have not for many years used the old **H**-shaped incision. If, however, this method be adopted (as may, perhaps, be occasionally advisable in cases accompanied by much thickening or by firm ankylosis) two lateral incisions should be made running over either condyle, and united by a transverse cut across the olecranon process. The flaps should then be thrown back and the ulnar nerve dissected out [and held aside by means of a blunt hook]. In the ordinary operation with a single incision, if the head of the radius is found dislocated on the back of the outer condyle (a very common condition in chronic disease of this joint), it may be removed at once with the bone-nippers. The joint should now be freely opened by dissecting round the olecranon, care being taken to keep the edge of the knife close against its inner side, in order to avoid the ulnar nerve, which is usually hidden from view amongst a mass of indurated cellular tissue. The end of the humerus should then be cleaned and turned out of the wound, the lateral ligaments being freely divided; the tip of the olecranon having been previously cut off, if necessary. However slight the disease in the bones may be, the whole end of the humerus just above the condyles ought to be removed. Afterwards the sigmoid cavity of the ulna should be sawn away. It is better, when it can be done without inconvenience, to make the sections of the two bones of the forearm on the same level. The wound should be brought together lightly. The limb should then be lightly bandaged on an angular splint, before the patient is restored to consciousness.[2] If troublesome hemorrhage occurs from the articular arteries at the beginning of the operation, an assistant should compress the brachial, and any vessel which continues to bleed after the removal of the bones should be carefully secured.

Ollier, Langenbeck, and others endeavor to preserve the periosteum in this excision.[1] For this purpose, after a free longitudinal incision over the olecranon, the periosteum is also to be freely incised and separated from the olecranon with a blunt or half-blunt instrument; then the tendon is to be carefully separated from the olecranon, leaving it still attached to the periosteum and surrounding fascia. In exposing the rest of the bones similar precautions are to be taken to preserve the periosteum and tendons in relation with each other and with the fascia. The advantages claimed for this method are that more perfect reproduction is said to ensue, and with more extended motion. Dr. Huëter asserts that the new joint is even provided with synovia, and he says that the movements of the new joint are sometimes more extensive than those of the natural elbow. Thus in one case the patient could lay the flat of his hand on the shoulder of the side on which excision had been performed, which was, of course, impossible on the sound side. This fact, however, seems to me rather to show the absence than the abundance of reproduced bone, and I shall show that the same freedom of motion exists after the ordinary operation. In M. Ollier's work the reader will find the most ample details on the "manuel opératoire," and on the results of this subperiosteal method of excision. His method of operation differs, though only very slightly, from that of Langenbeck. He gives a table of twelve cases operated on in the hospitals at Lyons.[2] Three of these died—a large proportion—due, as he believes, to the unhealthiness of the hospitals in which the patients were treated. In two of the other cases, the time which had elapsed was insufficient to allow of an opinion on the result. All the others had good movement, though in one (M. Dron's case) it seems to have been limited. One of the patients died (of scarlet fever) eight months after operation; but unfortunately an examination of the new joint was not obtained. It must be admitted, therefore, that the only perfectly convincing proof of the reproduction of the articular ends is still wanting in this series of cases. M. Ollier is, however, perfectly certain of the reproduction of a bony mass replacing the olecranon in most of the cases, and of the attachment of the tendon of the triceps to this bone; and also, in some instances, of the reproduction of bony projections from either side of the end of the humerus, giving great lateral stability to the joint. On the whole, therefore, I think we are entitled to conclude that the subperiosteal resection of the elbow, though more laborious than the older methods and requiring more time for its accomplishment, has occasionally yielded excellent results, and deserves to be tested by more extensive practice.

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[1] Health; its Friends and its Foes. Mussey, p. 352.

[2] Some surgeons—and among them, I believe, Mr. Syme (see his treatise on Excision of Diseased Joints, 1831, p. 70)—merely flex the arm, and apply a roller; but the support of a splint appears to give confidence, and to prevent spasmodic movements; it need not be applied at any particular angle, but merely in such a position as avoids tension on the sutures.

[1] I would refer the reader on this head to Huëter, in Langenbeck's Archiv, vol. viii., pp. 135 et seq.; Lücke, Aphorisms of Military Surgery, etc., p. 126; Stokes, in Dublin Quarterly Journal, May, 1865; and especially to Ollier, Traité expérimental et clinique de la Régénération des Os. Paris, 1867, vol. ii., pp. 338 et seq.

[2] A somewhat larger number of cases is given in M. Ollier's more recent publication, Des Resections des grandes Articulations—nineteen cases, with four deaths, which, however, were all in adults. Out of eleven cases under 30 years of age, none died.

My own experience of this method is limited to a single case,[1] in which, although it was a very good case for excision, and no bad symptom followed the operation, the motion ultimately obtained was considerably less than in a perfectly successful operation after the ordinary manner; and this appeared to me to depend on the excessive reproduction of the excised olecranon. M. Doutrelepont[2] has published an account of the dissection of a case in which this operation had been successfully performed at the age of 18, about four years before death. In this case the olecranon and coronoid process of the ulna, the head of the radius, and two-thirds of an inch of the humerus, were removed, the section of the latter bone running through the condyles. The drawings attached to M. Doutrelepont's paper show that the condyles of the humerus had been entirely reproduced—the internal condyle rather exuberantly, forming a deep groove for the ulnar nerve. The olecranon was also reproduced, and was longer and more curved than natural—a circumstance of much importance. The head of the radius was also reproduced, and was united to the ulna by an orbicular ligament, as in the natural joint. There was a regular joint between the ulna and humerus (an articular surface, surrounded by a capsule, being formed on the summit of the reproduced sigmoid notch), and true hyaline cartilage had also been reproduced. There was no appreciable shortening of the arm, and the muscles were as well developed on that side as on the other. Pronation and supination were almost natural, flexion and extension were perfectly good, but within the limits of 75° to 120° only.

In my own case, also, the limits of flexion and extension are about the same as the above; and here, also, I thought that extension was checked by the excessive reproduction of the olecranon, whereby its point was brought down into the coronoid fossa before the arm had been nearly straightened. M. Ollier has pointed out the danger of this limitation of motion by the curved shape of the new olecranon,[1] and proposes to rectify it by treating the arm in a more extended position than that ordinarily used, with adequate precaution, of course, against ankylosis.

Mr. Stokes, of Dublin, has been so kind as to inform me that he has practised the subperiosteal excision of the elbow five times. The first two operations, in children aged about 10 and 12, did extremely well, the wounds healing rapidly, with obvious reproduction of bone and excellent movement. The third patient died about two months after operation, and there was no opportunity of examining the joint. In the two other cases (adults), the power of flexion and extension was extremely limited—one almost ankylosed.

From all that I have seen and read on the subject, therefore, I must say that the advantages of the sub-periosteal method in this excision are at present doubtful.

The extent of bone which may be removed in an excision of the elbow is considerable; in fact, within the proper limits, it seems as if the more bone is removed, the better is the result. If only the extreme ends of the bones be sawn off, ankylosis will most likely take place; while if the amount above prescribed (viz., the whole condyloid extremity of the humerus and all the sigmoid cavity of the ulna with the head of the radius), or even a little more on both sides, be taken away, free motion may, under favorable circumstances, be expected. An exaggerated idea, however, appears to prevail, of the amount of bone which may be excised with a prospect of preserving a useful limb. This idea has originated from confusing operations undertaken for necrosis with those for injury or chronic disease (caries). In the former, the whole shaft of a bone has often been removed, and a useful limb left. In the latter, especially if the periosteum be removed with the bone, only a limited quantity of bone can be taken away. If the limits above pointed out have been somewhat exceeded, and still at the point of section the interior of the bones is obviously diseased, it is better, if the disease is not in a very advanced condition, to remove all the bone which is quite disintegrated, preserving what is merely softened, and thus give the patient a chance of saving his limb; but if complete disorganization extends far into the shaft, it is, I think, advisable to amputate, although perhaps in a young and healthy patient the operator might be justified in trying the subperiosteal extirpation of the diseased bone. The position of the line of section in relation to the junction of the epiphysis is a matter of subordinate importance in this joint, since it is of much more importance to obtain a flexible but firm union, so as to allow of good motion, than to avoid any amount of shortening of the affected arm.

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[1] The Practitioner, No. viii., Feb., 1869, p. 65.

[2] Langenbeck's Archiv, vol. x., p. 911.

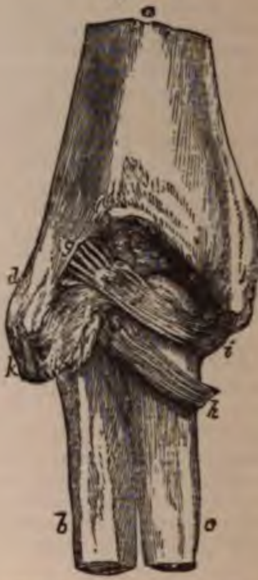
[1] Traité experimental, etc., vol. ii., p. 347.

The arm should be left perfectly quiet for a few days, in the position in which it has been placed after the operation. A good deal of irritative fever often supervenes. When it is necessary to change the dressings for the sake of cleanliness, a grooved splint should be applied, which will lodge the arm and forearm, and which is jointed in the centre and movable by a rack and pinion; with this apparatus, the arm may easily be got into such a position as will afterwards be useful, by gradually changing the angle. Passive motion, however, of a more vigorous kind must not be neglected; the time at which it is commenced varying with the state of the wound and the quantity of the bone which has been removed. If much has been taken away, ankylosis is little to be apprehended; otherwise, at a period which may be roughly stated at about three weeks, daily passive motion ought to be commenced. In the most favorable cases a very perfect false joint succeeds to this treatment; and an amount of motion is regained, which for practical purposes is little inferior to that of the original joint.

Of this a very interesting example is recorded by Mr. Syme, in which he had the opportunity of dissecting the new joint, nine years after the operation, which had been performed on account of injury—the man having in the interval acted as guard on a railway, swinging himself from one carriage to another while the train was in motion, with the injured arm, quite as easily and securely as with the other. The ulna was found united to the humerus by ligament; the end of the radius was polished off, and played on the humerus and on the ulna, a material something like cartilage being interposed. The ends of the bones of the forearm were locked in by two processes projecting downwards from the humerus, and strong lateral, and still stronger anterior and posterior, ligaments also bound them to the latter bone.

Union is, however, seldom so perfect as this, and the bones seem to be united merely by more or less extensible ligament.[1] In these cases, it is said by M. Robert[2] that flexion is composed of two movements; the forearm being first drawn up to the humerus by the triceps, and then flexed by the action of the biceps.

Fig. 629.



Reproduction of the elbow-joint after excision, in Mr. Syme's case. (From the Lancet, 1855, vol. i.), *a*, the humerus; *b*, the ulna: *c*, the radius; *d*, *e*, projections from the shaft of the humerus, locking in the bones of the forearm in the new joint; *f*, new orbicular ligament around the head of the radius; *g*, a portion of the ligamentous union between the ulna and humerus; *h*, tendon of the biceps; *i*, *k*, new lateral ligaments, attached below to the end of the ulna on one side, and the orbicular ligament on the other.

I append drawings from a case in which I excised both elbow-joints of a child aged five, four years since.[3] The drawings show the amount of motion obtained in a perfectly successful case by the old method, and they prove that when the preservation of periosteum is quite disregarded, the same extent and freedom of motion may be obtained as Dr. Hüeter (above quoted) appears to believe to be peculiar to the subperiosteal operation. Mr. Syme's case also shows that considerable reproduction of bone may ensue, by growth from the sections, irrespective of periosteal reproduction. These facts, together with the obvious and proved inconvenience of super-

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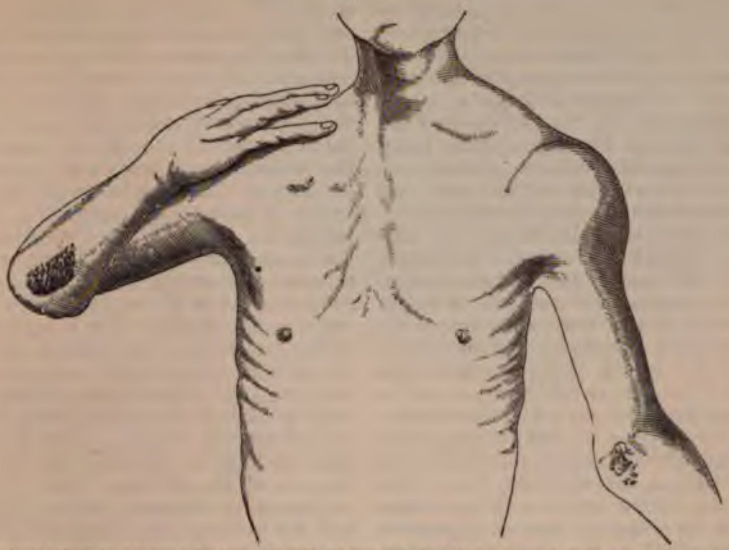
[1] Notes of the dissections of several cases, after successful excision of the elbow, may be found in Wagner On Repair after Resection—translated by the writer for the New Sydenham Society, 1860.

[2] Gazette des Hôp., Nov. 20, 1858.

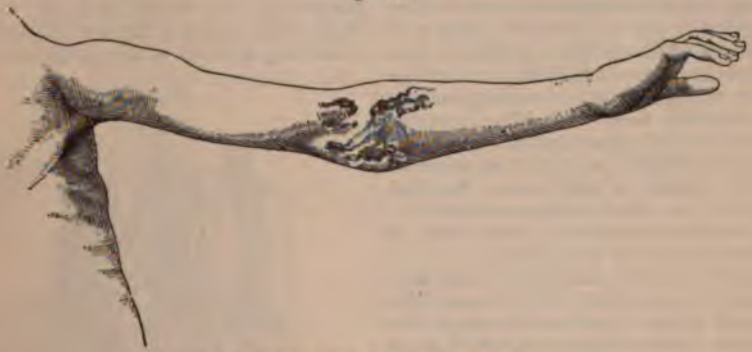
[3] Clin. Soc. Trans., vol. i., p. 143.

Fig: 630.



The excised elbow in extreme flexion. It will be noticed that this motion is more extensive than in the natural joint, the hand being laid flat on the shoulder.

Fig. 631.



The excised elbow in extreme extension.

abundant bony reproduction in this operation, tend still further to make us hesitate in admitting, without further experience, the advantages of the sub-periosteal method.

Osseous ankylosis ought very rarely to occur. If the ulnar nerve be injured, a good deal of wasting of the muscles and loss of motion has been observed to follow, and that even in parts not supplied by the injured nerve; and this fact should make the operator careful to avoid the nerve. On the other hand, cases have occurred to the most experienced operators, in which the nerve was wounded; and one is on record in which it re-united, and no loss of motion or other ill consequence followed.[1] If the patient recover, but with disease persisting or recurring in the ends of the bones, the question of again excising the diseased portions will occur. If necrosis be present, no doubt can exist of the propriety of removing the dead portions, should they be loose; but if the exposed parts of the bone be fixed, or if the disease be caries rather than necrosis, no operation should be performed while the functions of the member appear to be improving. When this is not the case, it is right to try once more to remove the diseased bone before sacrificing the arm. Even a third such attempt has been made, and, as it is said, with good results.

Excision of the elbow is usually considered, and in all probability correctly, as a more formidable operation in respect of mortality than amputation of the arm; but no data exist, as far as I am aware, for a correct comparison between the two. In Dr. Hodges' work there is a table of 119 cases, principally from the journals and other published sources; of these, 15 died; and in 15 others amputation was performed. In the great majority of the cases which survived, the usefulness of the limb was proved by the patient being able to resume his ordinary avocations; but the details as to the extent and kind of motions which resulted are not exact.

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[1] Syme On the Excision of Diseased Joints, 1831, case viii., pp. 88-94.

In the essays on INJURIES OF THE UPPER EXTREMITY and GUNSHOT WOUNDS the reader will find the indications for amputation, excision, or entire preservation of the limb, in cases of injury. In cases of ankylosis of the elbow excision is rarely required, although where true bony anyklosis has occurred in a bad position, excision may be performed if the patient wishes it; but in bony ankylosis in the flexed position, and in all cases of soft ankylosis, this operation is inadmissible. The former ought to be let alone; the latter are under the control of the methods described in the essay on ORTHOPÆDIC SURGERY. In cases of disease of the bones of the elbow excision is the operation which should be adopted, except under special circumstances necessitating amputation, such as unusual extent of implication of the bones, advanced age, great debility, or constitutional affection. But the rarity of such circumstances is shown by the fact, that Mr. Bryant's collection of 300 amputations[1] only includes 10 in which the arm was amputatated for disease of all kinds. So that excision of the elbow is the operation almost universally resorted to in cases of incurable disease of that joint.

[It may be well to add a few words here in regard to excisions of the elbow-joint in cases of injury. Such admirable results have been obtained in a number of cases in my own experience, that I should not hesitate to substitute this operation for that of amputation, if the great vessels were intact. In the case figured on p. 879, Vol. I., for example, it is very possible that a useful limb might have been obtained in this way.]

Excision of the wrist.—The operation of excision of the wrist has been entirely modified since the first edition of this work, in consequence of the labors of Professor Lister, of Edinburgh, published some years since in the Lancet. He has shown that the failures, to which the old methods of performing this operation usually led, were due in all probability to two chief causes, viz.: (1) a portion of the diseased articular strictures having been left behind, and (2) the tendons having been injured. In order to avoid the former, it is necessary to remove all the bony and cartilaginous structures which enter into the formation of the wrist-joint itself, and of all the carpal joints; viz., the ends of the radius and ulna (which must be divided at a level above the joint between those bones), all the carpal bones, and all the articulating surfaces of the metacarpal bones. In order to avoid the second cause of failure, the operation must be performed through two very free lateral incisions, the tendons being carefully separated from the bones and raised by gradual strokes of the knife with as little violence as possible. For this purpose an incision is made commencing in front over the second metacarpal bone internal to the tendon of the extensor secundi internodii pollicis, and running along the back of the carpus, internal to the same tendon, as high as the base of the styloid process of the radius. The soft parts, including the extensor secundi internodii, and the radial artery, being cautiously detached from the bones external to this incision, and the tendons of the radial extensors of the wrist being also severed from their attachments, the external bones of the carpus will be exposed. When this has been done sufficiently, the next step is to sever the trapezium from the other bones with cutting pliers, in order to facilitate the removal of the latter, which should be done as freely as is found convenient. The operator now turns to the ulnar side of the incision and

Fig. 632.

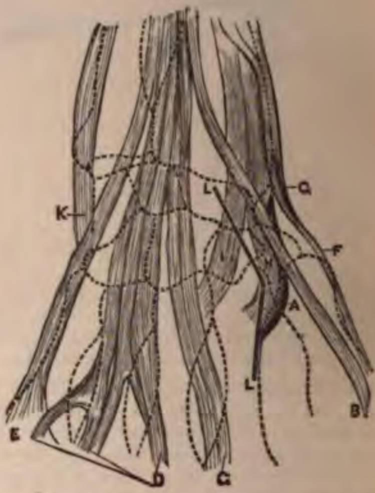

Diagram of the excision of the wrist (after Lister). A, the radial artery. B, tendon of the extensor secundi internodii pollicis. C, indicator. D, Ext. comm. digitorum. E, Ext. min. dig. F, Ext. prim. int. pol. G, Ext. oss. met. pol. H I, Ext. carp. rad. long. and brev. K, Ext. carp. uln. L L, line of radial incision.

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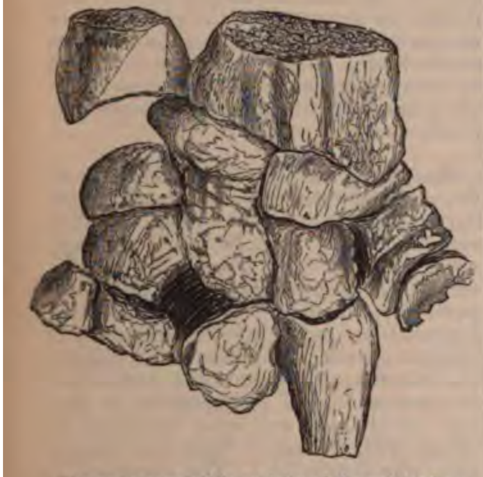
[1] Med.-Chir. Trans., vol. xlii.

cleans up the carpal and metacarpal bones as much as can be done easily. The ulnar incision is now made. It should be very free, extending from about two inches above the styloid process down to the middle of the fifth metacarpal bone, and lying near the anterior edge of the ulna. The dorsal line of this incision is then raised along with the tendon of the extensor carpi ulnaris, which should not be isolated from the skin and should be cut as near its insertion as possible. Then the common extensor tendons should be raised, and the whole of the posterior aspect of the carpus denuded, until the two wounds communicate quite freely together; but the radius is not as yet cleaned. The next step is to clean the anterior aspect of the ulna and carpus, in doing which the pisiform bone and the hooked process of the unciform are severed from the rest of the carpus, the former with the knife, the latter with the cutting pliers. In cleaning the anterior aspect of the carpus, care must be taken not to go so far forwards as to endanger the deep palmar arch. Now, the ligaments of the internal carpal bones being sufficiently divided, they are to be removed with blunt bone forceps. Next the end of the ulna is made to protrude from the incision, and is sawn off, as low down as is consistent with its condition, but in any case above its radial articulation. The end of the radius is then cleaned sufficiently to allow of its being protruded and removed. If this can be done without disturbing the tendons from their grooves, it is far better. If the level of the section is below the upper part of the cartilaginous facet for the ulna, the remainder of the cartilage must be cut away with the pliers. The operator next attends to the metacarpal bones which are pushed out from one or the other incision\and cut off with the pliers so as to remove the whole of their cartilage-covered portions. The trapezium bone, which was left in the early stage of the operation, is now carefully dissected out, so as to avoid any injury to the tendon of the flexor carpi radialis or to the radial artery, and the articular surface of the first metacarpal bone is then exposed and removed. Lastly, the cartilaginous portion of the pisiform bone is taken away; but the non-articular part is left behind unless it is diseased, in which case it should be removed entire. The same remark applies to the hooked process of the unciform.

Fig. 633.



The parts removed in excision of the wrist (after Lister).

The operation is one of the most tedious and difficult in surgery, but it appears to me to give very satisfactory results, and therefore should, I think, always be adopted in such cases as are favorable for any operation at all. It is advisable, if not necessary, to put on the tourniquet [or to use the Esmarch apparatus]; so that the view of the parts should not be obscured by the blood. It is also very desirable to break down freely any adhesions which the tendons may have formed, while the patient is under chloroform previous to the operation.

No tendons are divided in this operation except the extensors of the wrist, for the flexor carpi radialis is inserted lower down than the point at which the metacarpal bone is usually divided.

In order to ensure motion, particularly in the fingers, passive movements should be performed from a very early period after the operation. For this purpose, Mr. Lister places the limb on a splint with the palm of the hand raised by a large wedge of cork, fixed below it; so that the joints of the fingers can be moved without taking the limb off the apparatus. Special arrangements are made for keeping the splint steady and for preventing displacement of the hand to either side. Careful and methodical passive motion should be used to each several joint—to those of the finger and thumb almost from the day of operation, and to the wrist as soon as the parts have acquired some firmness, each movement, pronation and supination, flexion and extension, abduction and adduction, being separately exercised; and the patient should be encouraged to make attempts at voluntary motion as early as possible. In order to exercise the fingers, the portion of the splint which supports them may be removed while that on which the wrist is received is still left. Finally, when the rigid splint is left off, some flexible support is still to be worn for a long time.

Partial excisions of the wrist are, I believe, much less promising, although success may be obtained in some cases, especially those of traumatic origin. Thus Mr. West, of Birmingham, has lately published[1] an interesting account of two cases, in one of which he removed the ends of the bones of the forearm and the first row of carpal bones for a disease of traumatic origin. Exfoliation occurred from the carpal bones which had been left behind, and the patient recovered with a moderately useful hand. In the second case, one of rheumatic disease, an abscess had formed in the lower end of the radius; only the radius was excised. The patient recovered, with the powers of writing and of lifting heavy weights.

The operation of excising the wrist, whether totally or partially, is one which I think is seldom advisable, at least judging from my own experience, for, though anxious to test the value of the operation, I have found only one opportunity in six years in which I thought myself justified in doing so. The results in that case were satisfactory. Nor have I seen more than one or two instances in the practice of my colleagues at St. George's Hospital. In spite of the success of the practice followed by Mr. West, I have a strong preference for total over partial excision. But I have no hesitation in saying that these remarks are only meant to apply to the comparison between excision and the expectant treatment. Many cases, I believe, will terminate quite as well if judiciously treated by incisions when necessary, the removal of portions of bone as they become loose, and, above all, the constant and persevering use of passive motion to the fingers, as if excision be practised, and without the risk of operation. But if the comparison be made with amputation, the removal of diseased parts being plainly necessary, then the importance of preserving the hand and fingers, even if much mutilated, is so great that excision is the operation which should in all cases be first discussed, and amputation should not be performed unless the less radical proceeding is absolutely contra-indicated.

Excision of single bones of the hand.—The excision of some of the bones of the hand may be practised with advantage, especially if the tendons are unaffected and can be secured from injury in the operation. It is of especial importance to preserve the thumb by the timely excision of its metacarpal bone or first phalanx when universally diseased; and the benefit of respecting the diseased portion, and leaving the articulating head, is of course still greater. If the periosteum can be spared, there will be in all probability a more firm union between the severed ends of the old bone, in consequence of the production of osseous granules, or even larger pieces of bone, in the cicatrix. It is of little use to remove the phalanges of the fingers (except those of the terminal row), unless in a few cases where they are necrosed and loose, for the formal excision of these bones would almost invariably leave a useless finger. But occasionally, especially when the extensor tendons can be spared, the metacarpal bones may be made the subjects of operation; and here, as well as in the thumb, it is of much importance, if the extent of the disease allows it, not to open either joint, particularly the phalangeal.

No precise directions are necessary for such operations, which consist merely in exposing the diseased bone on its dorsal aspect, scraping off from it all the soft parts, including the periosteum if possible, dividing the bone with cutting forceps (the extensor tendon being held out of the way), then seizing the divided end with the lion-forceps, cleaning the bone on the lower surface, with much care not to dip the point of the knife into the palm, and finally, when the limit of the disease is reached, nipping off the bone. If the extensor tendon has been unavoidably severed, the finger must be carefully supported on a splint till this has reunited. In case of disease of the two middle metacarpal bones, it will be better to remove the diseased portions with a small chisel; and this plan is preferred by many surgeons in the other metacarpal bones also, in order to preserve the periosteum.

Excision of the hip is an operation, of the value of which the most widely differing estimates have been formed by different surgeons. Nor is this surprising, when it is considered that the disease for which it is usually undertaken is accompanied by exhausting and long-continued suppuration, rendering the prospects of surgical operation unfavorable; while, on the other hand, spontaneous recovery is so common that it is impossible in any case which gets well after operation to affirm with certainty that the natural cure was impossible. The operation is performed on account of gunshot wound or in advanced "strumous" disease, accompanied by abscess, where the patient seems in danger of dying of hectic, and the ulceration of the bone is judged to be incurable. The hip-joint ought never to be excised on account of deformity from ankylosis, although it may be advisable in appropriate cases to divide the neck of the femur, or even perhaps to cut a wedge-shaped piece out of it.[1] The operation of excising the hip, as it is commonly spoken of, means merely the removal of the head of the femur: but the acetabulum may also be removed, if it be thought necessary. The operation differs considerably in difficulty, according as the head of the bone is or is not in the acetabulum, and according as the surgeon does or does not require to obtain access to that cavity in order to remove its floor. In most cases of chronic disease the head of the bone has undergone that process of displacement usually, though not very accurately, spoken of as *dislocation*—*i.e.*, the lip of the acetabulum has been ulcerated or absorbed, and the head of the bone (also altered in shape from ulceration) lies partly on the dorsum ilii, partly on the edge of the expanded acetabulum, and is very probably covered by few if any muscular fibres. In fact, in cases of old-standing hip disease, the muscles have become atrophied from disuse, and the ligaments also have in a great measure disappeared. All that is necessary in the operation is to make an incision of sufficient length over the prominence of the bone, running somewhat behind the trochanter, and, having exposed the head of the bone, to saw it off at such a level as the extent of the disease seems to indicate. When, however, the head of the bone remains in the joint, and the ligaments are entire, as is the case generally in excision for injury, and in many of those for disease, the operation is not quite so simple; and it becomes still more difficult if the neck of the bone is fractured, so that the surgeon cannot get any purchase upon the head to turn it out of the acetabulum. In such cases an incision must be made, running behind and parallel to the posterior border of the trochanter, and long enough to admit of free access to the joint. The length will of course vary according to the size of the buttock, but it may be stated in general terms that the incision should commence near the junction of the trochanter and the shaft, and should curve (with its convexity backwards) round the prominent upper border of that process. By cutting now along the neck of the femur, the situation of the joint may be accurately ascertained, if it has been hidden by swelling from disease or injury; and, this having been done, the parts may be divided from within outwards in any direction which may seem convenient (according to the presence of wounds, etc.), so as to render the external incisions crucial or T-shaped. The flaps are now to be reflected. If the neck of the femur is fractured, the fractured part is to be seized with the lion-forceps, and cleared up to the head and round it, and so removed. Search should then be made for shots, foreign bodies, fragments of bone, etc. If, on the other hand, the neck of the bone is entire, and sufficiently strong to bear the requisite force, it may be more convenient to turn

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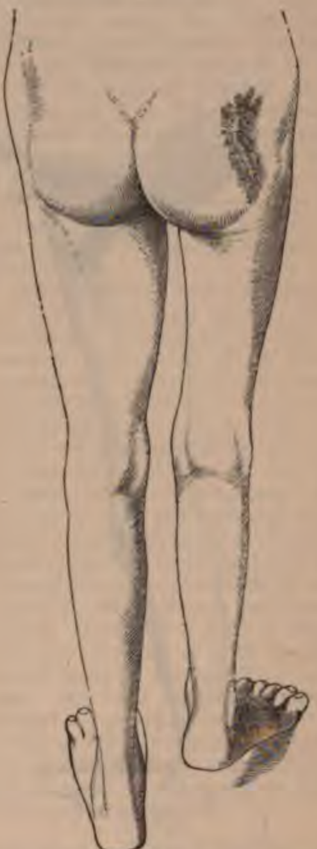
[1] Dublin Quarterly Journal of Med. Sci., February, 1870.

Fig. 634.



Excision of the hip. (From a case in which the whole floor of the acetabulum, as well as the head of the femur, had been removed several years previously.) To show the position of the wound, the amount of shortening, and the wasting of the limb operated on.

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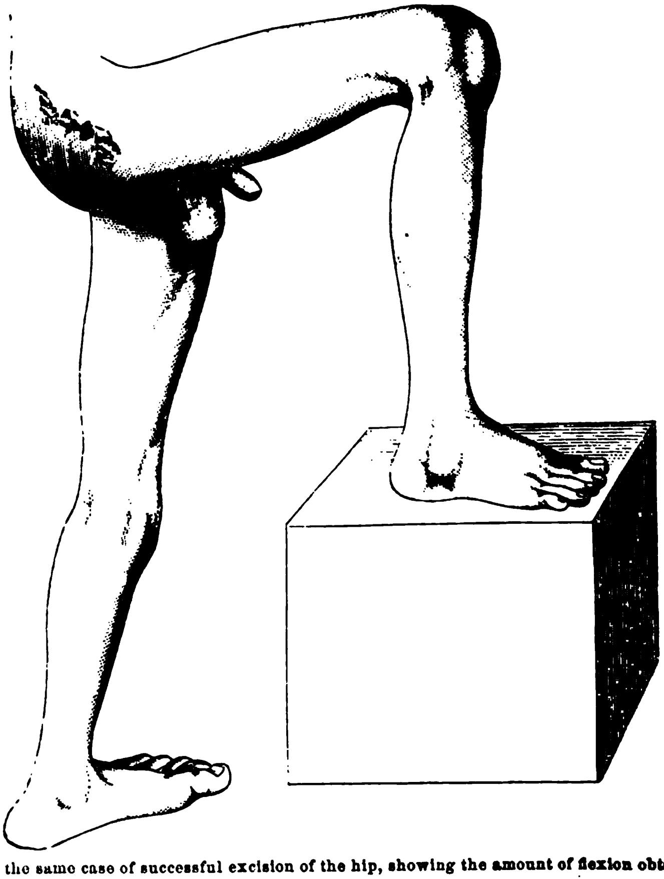
[1] I once saw a case in which the hip was fixed in acute flexion. The symptons induced the surgeon in charge of the case to perform an exploratory operation; but on cutting down, the joint was found free from active disease, but ankylosed. The neck of the femur was sawn through, and the thigh placed on a straight splint. The patient (a child) recovered, with a straight and useful limb. In such cases a subcutaneous operation similar to that practised by Professor Gross on the knee, would probably in most cases be the safest. (See ORTHOPÆDIC SURGERY.)

out the head of the bone, and divide the ligaments, as in ordinary exarticulation; otherwise the neck may be cut through with a keyhole-saw. This instrument should always be at hand, together with a trephine, elevator, gouge, etc., for removing impacted foreign bodies, or for clearing the acetabulum. In many cases the director, mounted on a handle, shown in fig. 609, is very useful. I think it better, whenever the disease does not extend very low down, to preserve at any rate a portion of the trochanter.

Thus far we have spoken only of the removal or decapitation of the head of the femur; but since the acetabulum is freely exposed in this operation, it is possible to carry it further, and remove part, or the whole, of the floor of that cavity; and this has been often done with success.

In Mr. Barwell's treatise on Disease of the Joints, p. 444, the reader will find an interesting account of a case in which Mr. Hancock removed the whole of the floor of the acetabulum, together with the head of the femur; and where, on the death of the patient, nineteen months after the operation (his limb having been useful in the mean time, although some disease still existed in the bones), an opportunity of dissecting the parts was presented. Mr. Erichsen removed not only the whole floor of the acetabulum, but also the ramus of the pubes and ischium, with part of the tuberosity of the ischium and a portion of the dorsum ilii; and reports that the patient had a useful limb.[1] I have obtained a very perfect result in a case from which the annexed figs. (634–37) were taken, where I removed the whole floor of the acetabulum. It is rather inaccurate in such cases to say that the operator has penetrated into the pelvis. A strong fascia still separates the wound from all contact with the viscera or their cellular connections.

Fig. 635.



From the same case of successful excision of the hip, showing the amount of flexion obtained.

The statistics of this operation are of little real value, nor are they of the same

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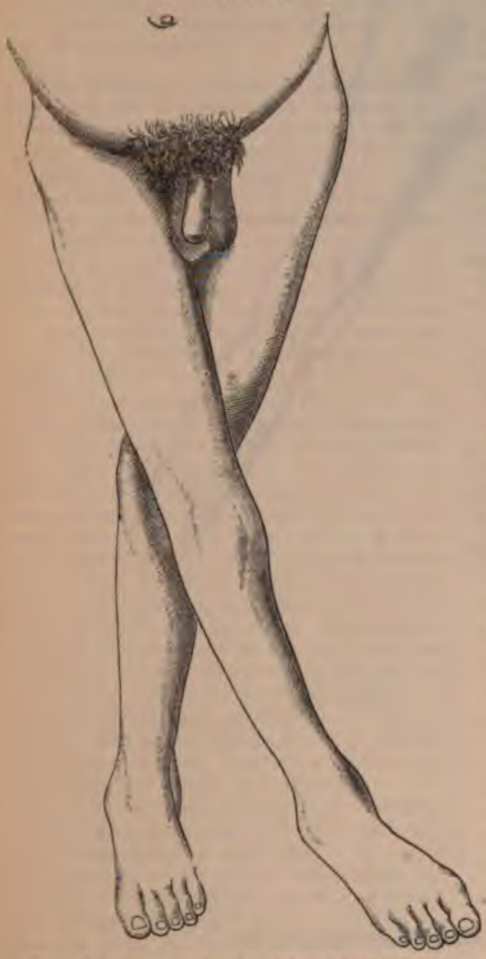
[1] Science and Art of Surgery, 5th ed., vol. ii., p. 241.

Fig. 636.



From the same case of successful excision of the hip, showing the amount of adduction obtained.

importance as in those excisions where the question lies between the removal of a joint and of a whole limb. The rate of mortality is extremely high; so that out of 111 cases collected by Dr. Hodges,[1] in which the result was known, 56 recovered "with more or less useful limbs," 53 died of the combined effects of the operation and the previous disease, and in the remaining two cases amputation was performed. But it is impossible to deduce any exact conclusion from such facts as these; since, without a personal knowledge of each case, no opinion as to the probability of recovery without operation can be formed. Possibly, more reliable conclusions as to the average mortality of operations may be deduced from the experience of individual operators, though here again there are many sources of fallacy. In my own practice, as stated in a work on the Surgical Treatment of Children's Diseases, out of 19 cases (all children) 6 died from the direct effects of the operation (in one case after amputation); 1 died after the operation from the previous effects of the disease; 1 died of independent disease some time after recovery from amputation; 2 recovered from the operation but not from the disease, and died a long while afterwards; 2 were little, if at all, benefited; 1 (twice excised) was doubtful; 3 had useful limbs, but with sinuses;[1] 3 recovered completely. In Dr. Cheever's essay on "Excision of Joints," in the Reports of the Boston Hospital, 1870, are notes of 11 cases under the care of himself and his colleagues. Two of them were adults, and both died; of the remaining 9, 2 died from tuberculosis, 1 had as yet a useless limb, like chronic hip-disease; 3 had useful limbs, but with sinuses; 1 had a good limb, but was lost sight of; 2 had recovered completely.

Excision of the hip for injury is a far more formidable operation than for disease. For this there are several reasons. The shock of all primary operations is great, and their mortality very high; nor are secondary operations after injury much more favorable. In the hip-joint the operation of excision for disease is very fatal in adult life, and it is only adults who, as a rule, are operated on for injury; and then again a compound fracture laying open the hip-joint is in itself a very severe shock, to which that of the operation is to be superadded. Hence we cannot wonder that the records of this operation should present an appalling death-rate. But then excision is only performed in gunshot injuries of the joint; and in these cases primary amputation is almost uniformly fatal,[2] while the expectant treatment can hardly be said to be much more promising.[3]

In the essay on GUNSHOT WOUNDS, it has been stated that out of eleven cases operated on in the Crimea, in Schleswig-Holstein, and

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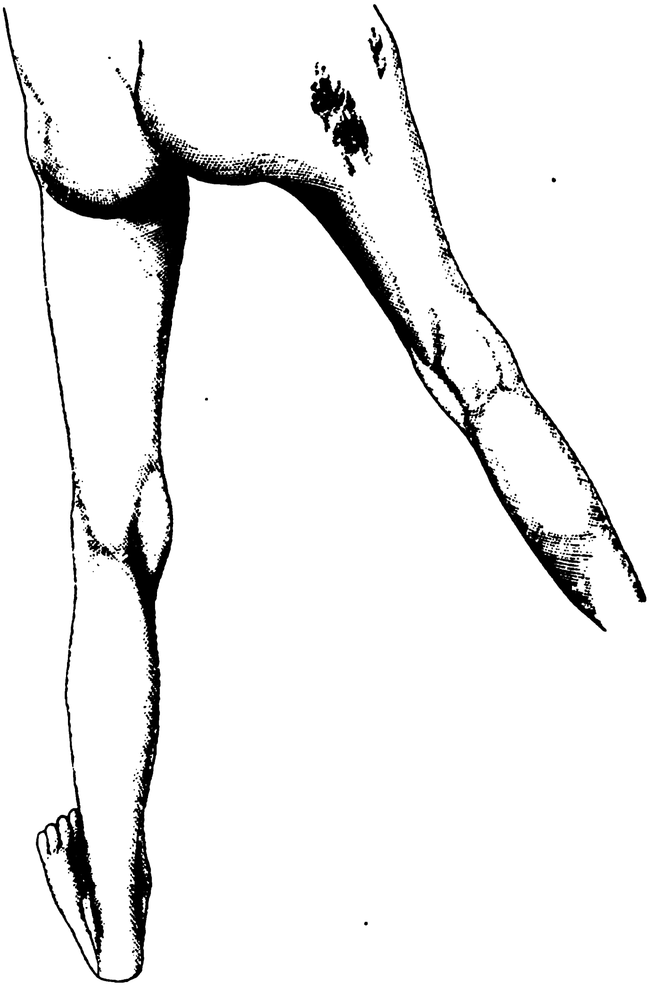
[1] Op. cit., p. 116.

[1] Some, if not all, of these have since recovered.

[2] See GUNSHOT WOUNDS.

[3] In the report referred to in the text, Surgeon Otis, U. S. A., writes: "I continue to share the convictions of Guthrie and the elder authors as to the uniform fatality of such injuries when abandoned to the resources of nature."

Fig. 637.



From the same case, showing the amount of abduction.

in the Italian war of 1859, only two patients survived, and one of these after amputation. Reference was also made to the experience of the American Civil War; but as that reference was necessarily imperfect, since the official documents had not then been completed, I think it would be useful to insert the following summary of Dr. Otis's official report on the subject of excision of the hip-joint for gunshot injury, for which I am indebted to Mr. Longmore's kindness.[1] The whole number of excisions of the hip-joint for gunshot injury known to have occurred during the American war was 63,—48 in the Federal and 15 in the Confederate armies. 32 of these were primary, *i. e.*, performed within 24 hours of the injury; 22 "intermediate," *i. e.*, from 2 to 28 days after; and the remaining 9 "secondary;" the shortest interval being 33 days, the longest nearly 7 months. Out of the 32 primary operations, 2 recovered, showing a death-rate of 93.75 per cent.; 2 out of the 22 intermediate—90.9 per cent.; and 1 out of the 9 secondary;[1] on the whole, 5 recoveries in 63 cases; deaths, 92.1 per cent. Doubtless, the mortality is very high; but viewing the almost necessarily fatal character of the injury, these results may be pronounced satisfactory; and may at any rate encourage a repetition of such attempts. In civil life the opportunity rarely happens; but I remember seeing one case under the care of a former colleague at St. George's Hospital, where I regretted that the operation was not tried. The patient, a young man, in dragging his gun through a hedge, had lodged the charge in the hip-joint, the neck of the femur having been cut cleanly across. He died a few days afterwards from the effects of inflammation and abscess in the joint. The pelvis was uninjured.

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[1] The facts are abridged from the Brit. Med. Journ., October 23, 1869.

[1] Another successful secondary operation is noticed in the report as having occurred in New Mexico in June. 1868.

The average duration of treatment in those of Dr. Hodges' cases in which the point was noted (49 in number) was 230 days. The high mortality and the very protracted period of convalescence certainly show that, even in many of those severe cases of hip-disease which alone are selected for this operation, the patient's prospects are not materially improved by it, although it must be allowed that the concurrent testimony in its favor of many eminent surgeons, who have had ample opportunities of watching its effects, justify a resort to it in cases which seem otherwise hopeless. The immediate effects of the operation are not often fatal, and it is, to say the least, extremely probable that where there is great and exhausting pain from pressure of the diseased bones on one another, the operation may save life. The greatest care, however, should be bestowed on the diagnosis of any case in which excision is contemplated. There are few instances of advanced hip-disease in which the external surface of the pelvis is not more or less involved. This fact (which may be judged of partly by the direction of sinuses, partly by the grating sensation elicited by passive motion under chloroform) is an unfavorable symptom, but forms no insuperable objection to the proceeding.

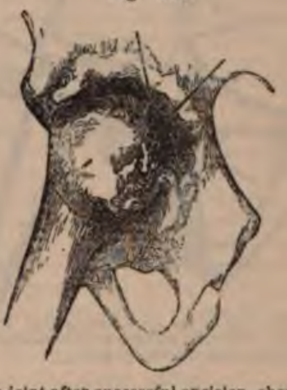
Abscess communicating with the interior of the pelvis near the joint is a still more discouraging symptom. It ought not perhaps to be stated absolutely (as was done in the first edition of this essay) that it ought to forbid the attempt to excise the joint, since it is possible that, by removing the floor of the acetabulum, a sufficient exit will be provided for the matter.[1] But even then the removal of the whole of the diseased bone is very improbable, and the operation must be allowed to be very unlikely to succeed. Abscess communicating with remoter parts of the pelvis, or extensive disease of the femur, or the presence of other strumous affections, ought certainly to forbid the attempt.

Adult age is a serious contra-indication to excision of the hip. A few cases of recoveries after the age of 20 are on record; but as a general rule the operation should be confined to childhood. In one of the successful cases in adult life the operation was performed for chronic osteo-arthritis.

The purport of these indications and contra-indications appears to be that excision ought never to be attempted except in childhood or youth, and never unless, with disease still progressing, the joint-surfaces are hopelessly displaced (a very rare occurrence), or the surgeon, on a careful review of all the symptoms, has strong reasons for concluding that natural recovery is impossible. When the operation is once decided upon, it should not be delayed till the patient's health has given way, but should be performed at once.

The recovery after excision of the hip-joint is very complete, as far as the movements of the limb are concerned, though the shortening is generally, I think, greater than after the spontaneous cure. The preceding figures (634–637) were taken from a lad in whom I excised the hip about five years ago, having removed the floor of the acetabulum so freely that three fingers could be passed through it. Every movement of the limb is perfectly free, and almost as extensive as in the natural condition.

Fig. 638.



The hip-joint after successful excision, showing the ligamentous cord by which the stump of the femur is united to the pelvis.

Bony ankylosis very rarely takes place. I have never seen it. The annexed illustrations (figs. 638–640), taken from a case where I had excised the hip successfully in a patient who died of another disease, show the usual condition of parts. They correspond closely with the state of things in an interesting preparation in the Museum of the Royal College of Surgeons, taken from the patient, in whom the operation was first performed, by Mr. White.

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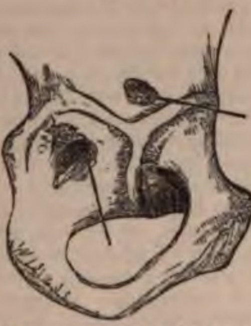
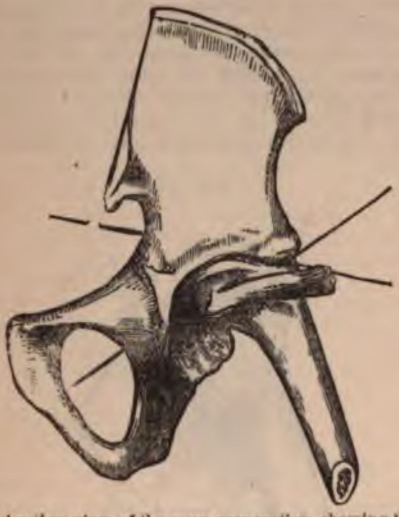
[1] Mr. H. Lee has related a very interesting case in which excision of the hip was attempted; but as the disease in the femur was found too extensive, amputation was performed. There was a large pelvic abscess, which was laid open by freely removing the diseased bone forming the floor of the acetabulum. The patient, a boy aged fourteen, rapidly recovered. (St. George's Hospital Reports, vol. i., p. 149.)

Fig. 639.



From the same case, showing the inner openings of two old sinuses leading through the acetabulum; their outer ends are marked by the bristles in fig. 638.

Fig. 640.



Another view of the same preparation, showing the end of the femur drawn up into the (enlarged) acetabulum by the tendon of the psoas.

Excision of the knee has been practised more frequently than that of any other joint, except the elbow; but the opinions of surgeons are by no means so unanimous on the former subject as they are on the latter; for whereas no one denies that amputation of the arm should only be resorted to in exceptional cases of disease and injury of the elbow, many hospital surgeons, in this city at any rate, think that amputation is advisable in the majority of the affections of the knee. There are many reasons why excision should be less successful in the knee than in the elbow. Firm bony ankylosis is required in the lower extremity; the treatment involves many weeks of strict confinement to one position; the surfaces of bone sawn through are very large; the cavity of the wound is badly situated for union; the epiphyseal lines are near, and if trenched upon in young subjects, the growth of the limb will, in all probability, be checked; the operation is more severe than excision of the elbow; and, finally, the advantage of preserving the foot, although considerable, is far less than that of retaining the hand. It is not likely, therefore, that this operation will ever come into such favor as that on the elbow; still, though it has been vehemently decried, and though its general adoption has possibly been equally retarded by its having been vehemently overpraised, it will always hold a place among the resources of operative surgery for the treatment of appropriate cases.

The acceptance which this operation has met with is not due to its lower rate of mortality. It has been clearly shown by the statistics collected by Dr. Hodges,[1] that in general practice the mortality has been about one-third; a far higher average than that after amputation at the lower third of the thigh for chronic disease of the knee; and from what I can learn of the statistics of metropolitan hospital practice, I believe the same rate of mortality has prevailed.[2] But this only imperfectly represents the ill success of the operation; for if to those who have died we add those whose limbs have been amputated, or have remained useless, we shall find that the failures after the operation at least equal the successes. In spite of this, however, it is the universal conviction of hospital surgeons that the operation ought to be introduced into practice. This conclusion must rest upon other considerations than those of the mere mortality after amputation and excision. It is not very probable that excision of the knee will ever be less fatal than amputation. There is no conceivable reason why it should be so. It is sometimes said that the hemorrhage is less; but I am far from convinced of this. The blood *shed* in an amputation is always greater than in excision; the blood *lost* is frequently less, for in a well-managed amputation the blood which gushes out is only that which was circulating in the amputated part, and little else is really lost to the system. In excision the operation is often a bloody one (though sometimes not so), and secondary hemorrhage is by no means rare. Then it is said that the wound is smaller than in amputation; but though the *surface* of the wound is smaller, its cavity (which is at least as important) is larger. The immediate shock, as far as I have seen, is generally considerable; quite as much so as in amputation.[1] The surfaces of bone exposed are very large, and the union of this great compound fracture, and the filling up of the large cavity left by the operation, call for considerable reparative power, and entail dangers from which amputation is exempt. But what has really brought excision of the knee into practice, and has compensated for the failures induced by its indiscriminate adoption in all kinds of cases, is its striking success in cases which are fitted for it; and it is, therefore, to the discovery of rules whereby such cases can be diagnosed, that the efforts of those who wish to promote this operation should be directed. The space which an adequate discussion of this matter would require not being here at my command, I must be excused for expressing summarily what I believe to be the correct indications for the performance of excision of the knee, as far as our present experience will enable us to lay them down.

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[1] Op. cit., pp. 142–8.

[2] See Brit. and For. Med.-Chir. Rev., July, 1862.

Excision of the knee should never be performed in elderly persons.[2] They have not usually the requisite reparative power; and the advantage over amputation is not sufficient, even in the most favorable cases, to balance the increased risk. There are many reasons also against performing the operation in very young children:[3] such as the probability of recovery without operation, if the suppurating joint be kept in a good position and freely opened; the risk of checking the growth of the limb by excision; the great probability that the joint-disease is but a symptom of constitutional mischief, in which case excision would do no good. No excision of the knee ought to be undertaken in a patient in whom there is any good reason to suspect, far less any evidence of the existence of, phthisis, or any other constitutional affection. Had this simple dictate of common sense been more strictly adhered to, many of the deaths which now give so gloomy a complexion to the statistical reports of excision of the knee would have been avoided. Excision for disease should be exclusively confined to cases in which the disease is in a chronic condition. In acute abscess the operation is inadmissible. In all cases where sinuses exist, leading for any considerable distance, and generally whenever the disease is of very long duration, excision should only be undertaken as an exploratory measure, and everything should be in readiness for amputation, if the softened condition of the bones should render the latter operation necessary; as will very probably be the case, even if no part should be found absolutely carious or necrosed. In deformity the result of old disease, if the disease have entirely subsided, orthopædic measures will most probably succeed; but if the case appears beyond their reach, no grave operation ought to be undertaken, except at the express instance of the patient; or, if a child, of his parents. The operation itself has its own peculiar difficulties and dangers in such cases; but, as a general rule, *operations de complaisance*, as the French call them, should never be pressed on the patient. Excision for injury, or primary excision, is very rarely required, or justified, in civil practice;[1] and in military practice (as stated in the essay on GUNSHOT WOUNDS) it is rarely feasible. The little evidence that we possess at present appears to show that the risk is greater than that of primary amputation. Primary excision ought not to be undertaken except in young subjects, and not in them except in those rare cases where, along with an amount of injury to the joint which renders preservation of the limb without operation hopeless, there is at the same time no such extensive wound, and no such injuries to the main vessels, as to necessitate amputation, and even in these rare cases it will be always doubtful whether the injury to the bones is limited to the neighborhood of the wound, and therefore the operation is always to be regarded as an exploratory proceeding, which may terminate in amputation.

The conclusion from all this appears to be, that the cases suitable for excision are those of incurable injury or disease of the knee, in which all the circumstances, both constitutional and local, are most favorable; in which the patient is in the prime of life, and free from visceral disease; and in which there is reason for hoping that the lesion has not spread beyond the epiphyseal ends of the bone.

The operation is thus performed: an incision should be made from the back part of one condyle to the back part of the other, passing across the front of the limb below the patella, and slightly convex downwards. It is seldom necessary to make any other incision into the skin;[1] but if there is much thickening about the soft parts, perpendicular incisions may be made at the ends of this so as to form the H-shaped incision, which used always to be employed in this operation. The ligamentum patellæ is to be divided in the first incision; then the soft parts are to be thrown back from the patella and the end of the femur, and the patella is to be removed.[1] The joint is now to be freely

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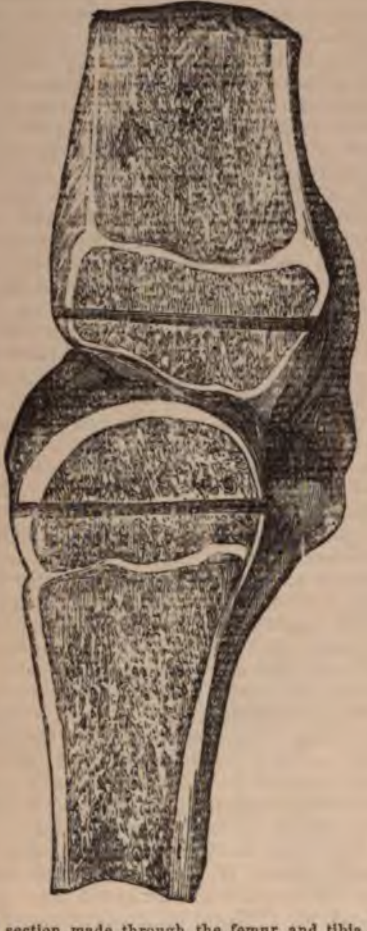
[1] I am informed by Mr. Henry Smith that in more than one fatal case at King's College Hospital death has been attributed to the shock of the operation.

[2] Speaking generally, and with due allowance for exceptional cases, I mean in persons above the age of forty-five.

[3] I do not mean to proscribe the operation in early childhood; in fact, I have often operated on very young children; but I regard the best age for this operation to be about puberty.

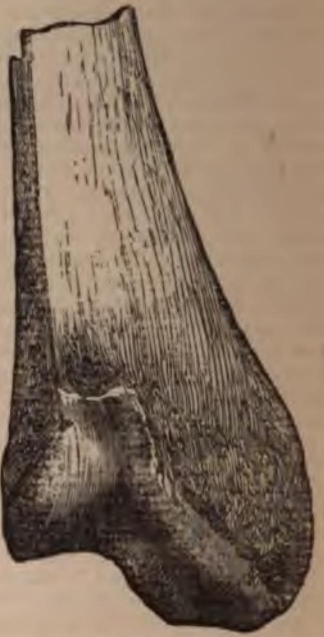
[1] Mr. Canton has published two cases in which he performed excision of the knee for injury; or perhaps, more strictly speaking, for abscess following injury.

Fig. 641.



A section made through the femur and tibia in a child aged five years, to show the position of the epiphysial lines and the point at which the section ought to be made in excision. If the section be made above the trochlear surface of the femur, at the level of the dotted line, the whole epiphysis will be removed. In the tibia, the whole articular surface may be removed without risk.

Fig. 642.



The same femur, shown in an anterior view, to mark the level at which the saw ought to be applied.

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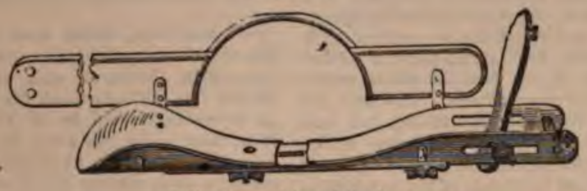
[1] Some surgeons prefer to make a long elliptical flap from the front of the limb, including the patella. I myself do not ordinarily use this method, as it makes a larger wound, and renders it somewhat more difficult to deal with the patella. It may, however, be necessary when there is much swelling.

[1] It is my invariable rule to remove the patella, and this is, I believe, the usual practice. I can see no use in the bone if left, and much risk of recurrence of disease. (See also Swaim, On Excision of the Knee-joint, p. 73.) Dr. Patrick Heron Watson, on the other hand, counsels its preservation, when possible, for the following reasons: "(1) That its removal is unnecessary in most cases; (2) that its presence in the flap bears up the soft parts from the line of incision, and, without preventing consolidation, helps to keep them away from the cut margin of either osseous surface; (3) that its removal occasions more bleeding; and (4) that the hollow left after its removal from the centre of the long flap leaves a hollow cavity, in which matter bags, and requires a separate incision to drain it efficiently." (On Excision of the Knee, p. 75.) If the latter assertion be well founded, it constitutes to my mind an additional objection to the use of the long flap in excision, rather than an argument for the preservation of the patella. None of the other supposed inconveniences of removing the patella will be found to be of any practical importance if the operation be performed with the simple transverse incision. As to the first assertion,

opened by cutting at the sides of the condyles, so as to sever completely both lateral ligaments; and then the knife is to be carried round the posterior surface of the end of the femur, care being taken in doing this to thrust the femur out of the wound as much as possible, by an assistant forcibly flexing the limb, and to keep the edge of the knife directed towards the bone, and guided by the finger, so as to avoid the popliteal artery, which here is separated from the bone only by some fat and loose tissue; and, in sawing the bone, it may be advisable, if the femur have not been very completely cleaned, not to pass the saw entirely through the osseous tissue, but rather to break than to cut the outer lamella at the back, by using the saw as a lever. The level at which the femur is to be divided should be carefully borne in mind in operating on children. I have repeatedly seen the surgeon take away the whole epiphysis and a part of the shaft from mere want of care, having forgotten, or omitted to ascertain, whereabouts this line is situated. Figs. 641–642 show its true position, and will prove that in any case of excision in which the whole cartilaginous surface of the femur is removed, the shaft will be trenched upon. The end of the femur having been removed, the head of the tibia is to be cleaned and sawn horizontally, care being taken in young persons to keep close below the cartilaginous surface, so that the epiphyseal line be not interfered with. In cases where there has been no dislocation, nor much alteration in the shape of the bones from previous disease, there is now usually no impediment to placing the limb in a straight position, with the bones in accurate adjustment. Otherwise they must be adjusted by taking off successive pieces from the end of the femur or tibia (if possible without going beyond the epiphysis); and in cases of old dislocation it is often necessary to sever some of the hamstring tendons. The parts should, in all cases, be adjusted in perfect position upon a splint, and the bandages firmly applied before the patient is moved or allowed to recover from the chloroform. If the femur appears at all prominent, a short splint should be applied in front in order to counteract the tendency of the leg to gravitate backwards (which is also assisted by the action of the flexor tendons); and it is at any rate a useful precaution to apply a long side-splint to the outer side of the limb, which can be discarded after the first few days, if it appears superfluous. I have found much comfort to the patient from suspending the whole apparatus in a "Salter's swing." It will of course be understood that the splints are interrupted and bracketed with iron at the seat of operation, so as to give access to the wound.

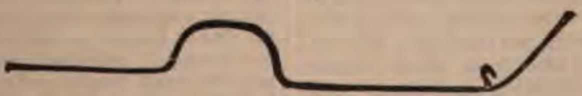
Fig. 643.



Splint for excision of the knee.

There are many other methods of dressing the wound and limb in cases of excision of the knee. Dr. Patrick Heron Watson warmly recommends the use of plaster of Paris (or plaster coated with paraffine externally, to render it less permeable to discharges), which he thus applies. Fig. 644 represents an iron rod, which extends from the groin to the foot, the upper straight end being at the groin, the arch at the site of the wound, the hook (for swinging the limb) near the ankle-joint, and the raised part running along the dorsum of the foot. Fig. 645

Fig. 644.



Dr. P. H. Watson's suspension-rod for excision of the knee.

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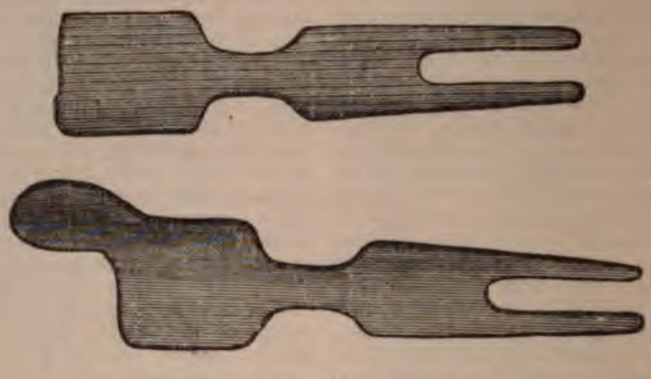
it is a matter of experience. In my own practice, the removal of the patella has seemed in the great majority of cases not merely advisable, but necessary.

shows two forms of "Gooch" splint, the former merely hollowed out on each side at the level of the wound and cut out at the lower part in a horse-shoe or stirrup form, to relieve the heel and tendo Achillis from pressure; the latter having also a piece above to be adapted to the innominate bone.

Fig. 645.



Dr. P. H. Watson's splints for excision of the knee.

"In application, the limb is first laid and carefully adjusted upon the posterior splint, which should preliminarily be padded with lint, and covered with gutta-percha tissue, or hot paraffine, in the position which corresponds to the site of operation. The iron rod is then placed in front, and folded lint laid between it and the limb at the groin, at the upper part of the tibia, and at the bend of the ankle. These two parts of the apparatus are then retained in contact with the limb by means of an *open wove* roller bandage applied from the toes upwards, the site of the incision being alone left uncovered. The whole is then rendered immovable by means either of plaster of Paris applied by the hand, of the consistence of thick cream, or of paraffine, which, having been rendered temporarily liquid by heat, is applied by a large painter's brush. When the application has solidified, the patient may be removed to bed, and the limb suspended from the running pulley of a Salter's swinging cradle, or from the roof-bar of the common iron-wire cradle." (Op. cit., p. 19.)

The advantages claimed for this method are the comfort the patient derives from being able to shift his position; the ease of transporting him from place to place (a great consideration in military practice); the facility of applying dressings to the wound; the permanence, simplicity, and facility of construction of the apparatus itself. My own experience of this treatment is limited to two cases, but these were sufficient to convince me of the reality of its advantages. The plaster-of-Paris dressing is in general use in this and other excisions by the German surgeons.[1]

Mr. Butcher has recommended[1] a "box-splint" for the after-treatment of this operation. This consists of two side-splints, the outer one extending from the axilla to below the foot, the inner from the groin to below the foot, jointed on to a back piece. The sides are let down to dress the wound. This is, as far as I have seen, a convenient apparatus when all goes well, but is less handy when complications occur, and is, on the whole, I think, inferior to the above-mentioned methods of treatment.

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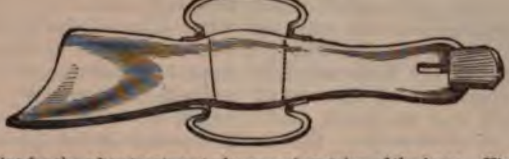
[1] "Als wir hier mit diesem Verbande für Kniegelenksresectionen unsere ersten Versuche machten, zeigte sich derselbe so ausserordentlich praktisch und einfach, dass Herr Prof. Esmarch sich sofort veranlässt fühlte, das Princip auch für andere Gelenke zu verwerthen, und ist in Folge dessen dasselbe hier nicht nur auch für Fuss- und Ellbogen-Gelenk zur Anwendung gekommen, sondern auch mit bis dahin sehr befriedigendem Erfolg für eine Hüftgelenksresection.

"Die Patienten liegen, an welchem Gelenk auch die Resection ausgeführt ist, ausserordentlich bequem, können vom ersten Tage an ohne Beschwerde jede Stellung einnehmen, und was uns noch besonders vortheilhaft erschienen ist, wir haben in allen Fällen. . . die Nachbehandelung ohne Verband zur Anwendung gebracht. Ich glaube wenigstens, das man nur diesem Umstande es zuzuschreiben hat, das man eine Kniegelenksresection von Anfang bis zu Ende behandeln kann, ohne jemals durch eine Spur von Geruch belästigt zu werden; ja, ich glaube sogar, das man das auf keine andere Weise erreichen könnte. Dabei ist der Verband und das Glied fast beständig rein, weil der Eiter aus der Wunde hervorgedrungen, über das Glied und die durch Firniss vor Imbibition geschützte Schiene sofort herablauft und in das untergesetzte Gefäss tropft."—From Dr. Zerssen's Graduation Thesis at the University of Kiel, in 1868. I may, however, add that even more rapid cures and more complete absence of foul odor or profuse suppuration have been attained by the method introduced into practice by Professor Lister (see infra, in the essay on AMPUTATION). My colleague, Mr. Pick, treated a case of excision of the knee, in a child, by this method recently, in which the whole wound healed in a fortnight. The two methods may of course be combined.

[1] Operative and Conservative Surgery, p. 142.

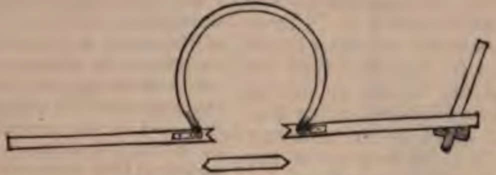
[Figs. 646 and 647 show two forms of splint which have been extensively used in this country in cases of excision of the knee, and have proved very satisfactory.

[Fig. 646.



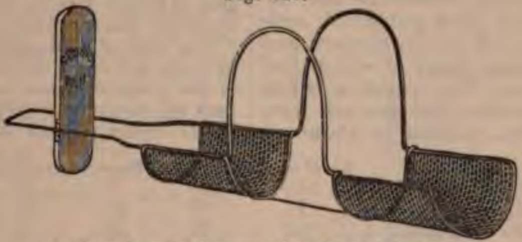
Packard's splint for the after-treatment of cases of excision of the knee. View from above.

Fig. 647.



The same, viewed from the side.

Fig. 648.



Ashhurst's splint for cases of excision of the knee.]

It is an essential element in the success of this operation not to be forced to disturb the limb at all for several days; hence the dressings should be most carefully applied at first. And for the same reason all bleeding vessels should be carefully secured, so as to avoid secondary hemorrhage. The bleeding during the operation is often very free, from the enlarged articular vessels; and secondary hemorrhage is by no means rare, and is a very unfavorable occurrence. The operation, especially when it has been a protracted one, which in cases of old dislocations it often is, is usually followed by a considerable amount of fever, subsiding with the establishment of a free suppuration; and then, in favorable cases, the work of repair commences by granulation and osseous union, as in compound fracture. In unfavorable cases, the bones become denuded and ulcerated in the suppurating cavity, the discharge is offensive, the wound unhealthy, fresh abscesses probably form, and the patient's health, instead of improving from the removal of the disease, shows a tendency to decline. Under these circumstances, chloroform [or ether] should be administered and amputation performed, if on examination it proves necessary.

The process of recovery is usually a slow one. In Dr. Hodges's tables, already referred to, the duration of the treatment in 48 cases in which the patella was removed is stated to have been 225 days; and in 38 cases in which that bone is believed to have been left, 255 days; or, roughly speaking, the average duration of treatment was about eight months; and in many of the cases which afterwards turn out the most successful, sinuses remain open, and the limb is in a state which cannot but cause anxiety for many months after formal treatment is discontinued.[1] In some exceptional cases, indeed, matters go on much more rapidly than this, and the recovery is completed as soon as (indeed, it may be that one or two have recovered sooner than) after amputation; but, as a general rule, the time required for recovery after excision may be taken at about four times as long as after amputation. In fact, I think we are taking a view very favorable to excision, if we say, that every month after the operation advances the cure only as far as a week would after amputation.

What is the value of the limb which is obtained by this operation, at the cost of such increased risk and so much additional suffering? Unfortunately, this is a question, the answer to which has been so distorted by the rash and exaggerated statements of the indiscriminate advocates of the operation, that no impartial person can profess to be able to solve it. I have seen, in many cases, most excellent limbs left after excision; far superior both for appearance and utility to any apparatus which could be manufactured after amputation, and still more to the ordinary wooden leg: and it is on account of the occurrence of such cases that I believe excision ought to be practised upon the most favorable cases of disease of the knee; but I utterly disbelieve the accounts which have been published, resting upon statements in newspapers and periodicals, of cases, many of which had not recovered from the operation, while in a great proportion the sinuses were still open, and the patient in about an equal chance of saving his limb or losing it. No case is be accepted as a successful one of excision of the knee, without *precise* information as to the following facts: Whether the wounds were all closed; whether the union was so firm as no longer to permit any motion; whether the patient could walk, and, if so, with or without apparatus; and what were the respective measurements of the limbs. It is true, that to have waited long enough to satisfy these queries would have somewhat delayed the appearance before the world of some brilliant cases, and perhaps have condemned many of them to perpetual obscurity; but, on the other hand, it would have made the information, when it did appear, useful and trustworthy, instead of, as at present, either useless or deceptive.

As far as Dr. Hodges could discover, from the data furnished by published accounts, out of 208 cases of excision, 102 failed utterly, as proved by death or amputation; and of the remaining 106, there was reason for thinking that in 65 cases the limb was useful, and in 14 partially or entirely useless; 27 being left quite doubtful; but from the nature of such accounts this conclusion cannot be a very confident one. Out of 19 cases occurring at St. Thomas's and St. George's Hospitals together, of which I have trustworthy and sufficient details, the limb was useful in 10 cases; but 9 of these were children.

The results of English practice, as far as he could ascertain them, from the invention of the operation down to a very recent period (not expressly specified) are thus tabulated by Mr. Swain in 1869:—

	No. of cases	Recoveries	Deaths	Amputations	Recoveries	Deaths
Recorded in Price's book up to 1865	316	240	76	39	30	9
Collected by Mr. MacCormac . .	74	49	25	11	7	4
Tabulated by Mr. Swain himself .	82	67	15	4	4	0
	472	356	116	54	41	13

Thus we have 472 cases, with a mortality of 116 = 24.57 per cent. Of the 356 who recovered from the immediate effects of the operation, 54 underwent subsequent amputation (13 of them dying), leaving 302 with useful limbs.[2]

I give this table as Mr. Swain gives it, and cordially agree with him in his low estimate of the value of such statistical information. Such tables can in fact prove very little. They do indeed show that the mortality has diminished: but whether this has arisen from improved surgery—that is, from a better style of operating and after-treatment—or from a more indiscriminate application of the operation to cases of slighter disease which need not have been operated on at all, but in which the patients will of course be more likely to survive operation (and which I would call deteriorated surgery), neither is nor can be shown by statistics. It is also a somewhat suspicious feature in Mr. Swain's table that all the 302 recoveries are claimed as being with useful limbs. If the information had been at all adequately full, there would surely have been a category of recoveries with the limb more or less useless.

Another very serious consideration in cases which recover with useful limbs is, whether that usefulness will be permanent. It is now a well-known fact, that the utility of the limb in many cases in which it seemed perfect at first has been destroyed by subsequent changes. In adults, the union, although it has appeared quite firm, sometimes proves not to have been so, and the limb bends under constant use, and yields to the power of the flexor muscles, until the foot no longer touches the ground, and the whole extremity becomes an incumbrance instead of a support. Sometimes it bows outwards or inwards, but with the same general result. Occasionally disease recurs, after a shorter or longer interval of apparent health, either spontaneously or as a consequence of some accidental injury or over-exertion.

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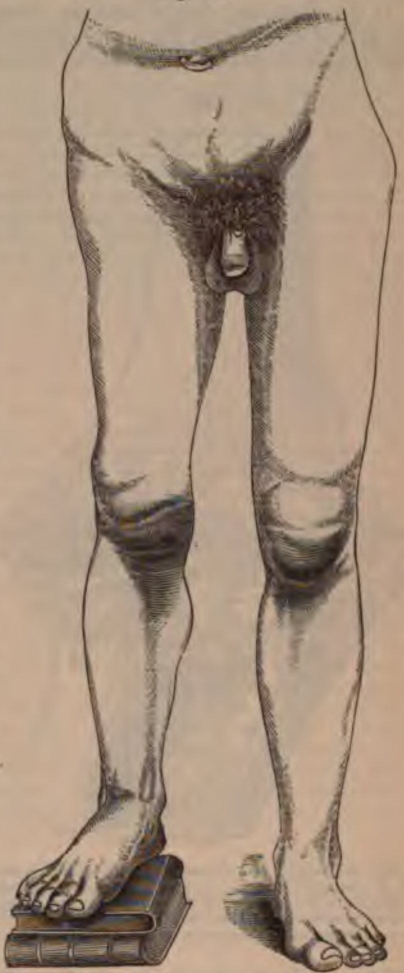
[1] In a series of eight successful cases, all of them in children, at St. Thomas's Hospital, for the notes of which I am indebted to Mr. Allingham, the average duration of treatment was 206 days. From the notes of 50 successful amputations of the thigh, at St. George's Hospital, I find that the average stay in hospital was 53 days. This includes patients of all ages. Children and young persons, such as are alone the subjects of excision, recover from amputation more rapidly than the average.

[2] Swain, op. cit., p. 64.

Suspension of growth after excision of the knee in childhood is very liable to occur; and is usually caused by removal of the entire epiphysis,[1] with encroachment on the shaft of the femur, and possibly of the tibia also. I have already spoken of the precautions which ought to be taken in operating on children to avoid this, and I believe that in most cases the disease can be entirely removed and the epiphyseal line left intact. But allowing that shortening occurs even to a very great extent, the limb may nevertheless be very useful. For a proof of this I would refer the reader to various cases published by myself and others, which have been quoted by Mr. Swain,[2] and for the details of which I have not space here, and to some admirable remarks by Sir W. Fergusson in the sixth of his lectures On the Progress of Anatomy and Surgery, illustrating the value in these cases of the preservation of the healthy leg and foot.

I recently saw a case in which I had operated eight years before, and where I had been obliged to remove the femur higher than the epiphyseal line,[3] and in whom therefore there had been progressive shortening. The patient has now attained the age of twenty-two; his growth appears complete; all irritation in the site of the wound has long since disappeared; the shortening now reaches six and a half inches; it is compensated partly by a dropping of that side of the pelvis to the extent of about two inches; the heel of his boot measures four inches in height; he walks with a slight limp, can walk any distance, and at the rate of over four miles an hour, and has done twenty-five miles in a day without fatigue. The muscles of the thigh on the side operated on are much wasted.

Fig. 649.



Result of successful excision of the knee. (From a photograph.) To show the dropping of the pelvis on the affected side, by which the shortening is partly compensated, and the atrophy of the muscles of the thigh which follows on disuse of the knee-joint, while those of the leg are little affected.

The repair after excision of the knee may be illustrated by reference to the preparation figured on p. 230. It is true that this was not a completely successful case; but repair was very far advanced, and had it not been for the visceral disease, it would, I doubt not, have been completed. As the case was under my own care, I may add that it serves also as an "exemplar ad evitandum," showing the deformity which is sometimes, in spite of all ordinary care, introduced into the union by displacement of the bones of the leg, and which both renders the limb less straight and comely, and doubtless tends to weakness in the union and subsequent displacement.

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[1] Suspension of growth has, however, been noticed in one case at least, under Mr. Syme's care, where the epiphyseal lines appear to have been left intact.

[2] Op. cit., pp. 141 to 148.

[3] Surgical Treatment of Children's Diseases, 2d ed., p. 486.

If the limb be simply bent in consequence of soft union, the only treatment required is to straighten it under chloroform, and keep it straight in a carefully fitted splint for some months, with due attention to the general health, the patient being put in good pure air, and allowed to take moderate exercise upon crutches. When disease is present in the bones, it becomes a question whether the diseased bone can be removed, or whether the limb should be amputated. Some surgeons have even proposed the complete re-excision of the false joint by an operation similar to the original one—a proposition highly worthy of consideration if the patient has attained his full growth and is in good health, and the shortening left by the first operation is not great. Such re-excision must, however, always be proposed to the patient as an exploratory operation, which in many cases will have to terminate in amputation.

Fig. 650.

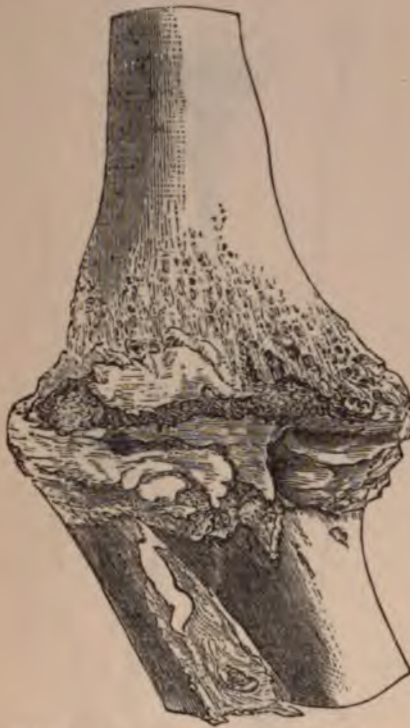
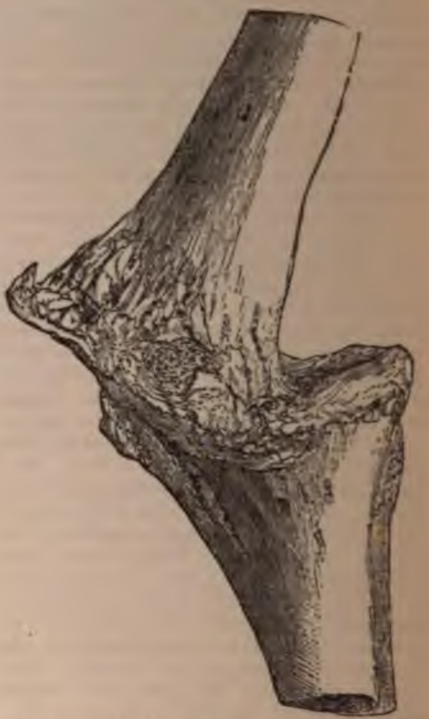


Fig. 651.



Two views of a preparation, showing almost complete repair after excision of the knee. (From the Museum of St. George's Hospital.) Fig. 650 shows the uniting medium almost perfect, but slight carious disease still going on in the bone. Fig. 651 shows the tilting backwards of the bones of the leg, or "riding of the femur," which is so liable to occur after this operation. The patient, a girl about the age of puberty, had nearly recovered from the operation when signs of renal disease showed themselves, and she gradually sank.

Excision of the ankle.—In the first edition of this essay I spoke discouragingly of the operation of excision of the ankle, not having at that time had any personal experience of the operation in my own practice, though I had seen many cases under the treatment of others, and those very eminent surgeons. My individual experience is still very limited (in fact, the operation is one which is rarely indicated), but it has been very satisfactory, being confined to two cases which recovered rapidly, and, as I believe, completely. The operation is one on which a wide difference of opinion prevails. There are many surgeons who have never practised or witnessed the operation, many who are entirely opposed to it on principle, believing amputation at the ankle-joint preferable; others who, after a limited and unsatisfactory experience of it, have abandoned it; and, lastly, others who, like myself, believe that it is very advisable and advantageous in appropriate cases, but believe, also, that those cases are rare. The cases to which I allude are those in which the disease is of traumatic origin, and the patient in the vigor of life, unaffected by any constitutional malady. In such cases the inflammatory softening, or suppuration, does not usually extend far from the neighborhood of the joint originally implicated, and after the removal of the diseased bone, the parts take on a healthy action, and become rapidly consolidated. In strumous disease, on the other hand, inflammatory softening, if not diffused suppuration, often exists in the tarsal bones or the bones of the leg, in parts not exposed to view in the operation; and in patients laboring under general constitutional affections, the parts operated on, instead of consolidating, usually soften, and after a long and exhaustive suppuration, the bones are found carious, leaving no resource except amputation, and that under very unfavorable circumstances. Again, as to the extent of the local disease. A case, to be strictly a favorable one for excision of the ankle, ought to be one in which the lesion is limited to the epiphyseal ends of the bones of the leg on the one side, and to the astragalus on the other.[1] Still, cases are on record in which most extensive excisions, involving the ankle-joint, and more or less of the tarsus, have been followed by complete success,[2] but it must always remain a question in any given case whether the prospect of complete and speedy cure by amputation ought not to outweigh the doubtful chance of preserving the mutilated foot, which after all may be of little use, even should it continue free from recurrence of disease.

With respect to excision of the ankle for injury, I need say little as to the use of the operation in military surgery, since the question has been elsewhere treated (see the essay on GUNSHOT WOUNDS). The successful experience, however, of Langenbeck in this operation, besides its special bearing on military practice, is also important in considering the general question of the advisability of attempting resection in preference to amputation in severe and incurable injury of the ankle. M. Ollier's experience, though not so extensive, is perhaps still more to the purpose in this respect, that it is gained entirely in civil practice.

He reports (loc. supr. cit.) that he has practised resection three times for comminuted fractures of the lower ends of the bones of the leg. In one case—a man 49 years of age—about one-third in length of the tibia was removed (12 centimetres = about 4 inches). The reproduction was not complete, but the patient recovered sufficient power to carry on his trade of a cooper.—In the second case, 7 centimètres in length of both bones were removed. The patient, a midwife, was at the time of the report (length of time after the operation not stated) able to walk with a stick and to attend to her business.—In a third case, the patient died of cerebral complications produced by the same injury. A still larger portion of bone (16 centimètres) had been removed, and all was going on well as far as the operation went.—M. Ollier also refers to another case under the care of MM. Jambon and Aubert (of Mâcon) where 10 centimètres of the tibia were removed; the patient had completely recovered, could walk ten miles, and dance for hours together.

Mr. Hancock, in his lectures at the Royal College of Surgeons in 1867,[1] referred to numerous cases in civil practice in which excision of the ankle (or at least of the extremities of the bones of the leg) had been practised successfully on account of injury. Nineteen successful cases are referred to by Mr. Hancock (one of which is of peculiar interest, inasmuch as the operation was practised on both sides), and he mentions that "Heyfelder gives 26 examples of this operation, of which 5 died, and 1 suffered consecutive amputation; while Jaeger, on the other hand, records 24 cases, 23 of which proved successful, and 1 died."

In almost all cases of excision for injury, the operation has been rather a resection of the fractured ends of the tibia, fibula, or both, than a complete excision of the ankle.

These facts appear to demonstrate that in complicated injuries about the ankle, resection may be performed with good hope of success if the patient be healthy, and if the after-treatment be judicious.

We are not in a position to lay down rules for the preference of excision over the expectant treatment on the one hand, or amputation on the other. "Each case," as Mr. Holthouse says,[2] "must be studied separately, and the means adapted to the circumstances present." But I think that we may conclude, generally, that excision is preferable to amputation in young patients of healthy constitution and habits, and that it is preferable to the expectant treatment in cases of great comminution of bone associated with comparatively slight injury to the soft parts.

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[1] M. Ollier would still further restrict the application of this excision. He says: "C'est seulement pour les ostéites épiphysaires des os de la jambe, avec propagation de l'inflammation suppurative à l'article, que je crois cette resection nettement indiquée." (Des Resections des grandes Articulations, p. 26.) Lyon, 1869.

[2] In one case referred to by Dr. Hodges, the ends of the tibia and fibula, the whole of the astragalus, part of the os calcis, and the three cuneiform bones, were removed; in another the end of the tibia, the astragalus, scaphoid, and two of the cuneiform.

[1] Lancet, vol. ii., 1867, p. 121.

[2] INJURIES OF THE LOWER EXTREMITY, Vol. I., p. 981.

With regard to the operation itself, I cannot do better than quote Mr. Barwell's description of the operation, as originally devised by Mr. Hancock, and which is, as far as I know, the best operative procedure for the removal of the entire joint; that is to say, the ends of the bones of the leg and the articular surface, or, if necessary, the whole of the astragalus. "The foot is first laid on its inside, and an incision is made over the lower three inches of the posterior edge of the fibula. When it has reached the lower end of the malleolus, it forms an angle, and runs downwards and forwards to within about half an inch of the base of the outer metatarsal bone. The angular flap is reflected forwards; the fibula, about two inches above the malleolus, is sufficiently cleared of soft parts to allow cutting forceps to be placed over it; and the bone is then nipped in two and carefully dissected out, leaving the peroneus longus and brevis tendons uncut. The foot is now to be turned over. A similar incision is made on the inner side, the portion on the foot terminating over the projection of the inner cuneiform bone. The flap is to be turned back, and the sheaths of the flexor digitorum and posterior tibial tendons exposed, the knife being kept close to the bone, avoiding the artery and nerve. The internal lateral ligament is then to be severed carefully, close to the bone; and now the foot is twisted outwards, and the astragalus and tibia will present at the inner wound. A narrow-bladed saw, put in between the tendons into the inner wound, projects through the outer. The lower end of the tibia, then the top of the astragalus, may be sawn off in a proper direction. The only vessel that may require tying is one of the lower branches of the peroneal artery. The wound may be closed with sutures, except that part opposite the breach of osseous matter; the leg and foot placed on a splint with a foot-board, and cold water applied."

Dr. M. Buchannan has also described[1] an operation for excising the ankle-joint, by making a curved incision over the external malleolus, removing this process with the bone forceps, dislocating the joint by inverting the sole of the foot, and thus obtaining access to the diseased bones without dividing any important parts, the peronei tendons being the only structures necessarily divided. This proceeding is merely a portion, as it were, of the one described by Mr. Barwell. It cannot give so free an access to the bones as is obtained by the former; but it may be adopted in cases where the end of the tibia does not require entire removal with the saw. The operation may, therefore, be commenced by making merely the incision on the outer side; and then if it be found necessary, that on the inner side may be added.

Langenbeck and Ollier have preferred the subperiosteal method of operating, and for the removal of large portions of bone in recent injuries there can be no question that this method should be preferred. In disease I think the method is of little consequence, because I do not believe that any large quantity of bone could be removed with success, unless for necrosis, when the periosteum would probably separate of itself. If only a small slice of the bones of the leg were removed, I should think it a matter of little consequence whether reproduction occurred or no. No express directions are needed for the subperiosteal operation beyond those given at p. 204.

I have elsewhere[1] pointed out the advantages which are to be derived from the removal of the entire astragalus in cases where that bone is at all extensively affected. In fact, whenever the disease appears to have commenced in the astragalus, I think it is better to remove the whole bone; and still more is this the case if the sides of the bone are ulcerated and freely exposed, since in such circumstances the lower surface will also probably be found affected. Such was the case in the instance to which I refer, and from which figs. 652 and 653 are taken. They show the implication of all the articular surfaces of the astragalus, except that of its head, in the ulceration. The removal of the whole astragalus requires free incisions, and is somewhat laborious, but it affords complete access to the upper surface of the os calcis, which can be removed, if necessary, with the chisel, and even to the anterior part of the tarsus, if it should be judged necessary to deal with this. In the after-treatment, perfect rest of the foot is essential until the parts are somewhat consolidated. When this is effected, the foot may be supported on a splint, and the patient be allowed to go about, resting the knee on a wooden leg. I have hitherto treated my patients in the way which is common, in compound fracture of the leg, at St. George's Hospital, viz., by confining the foot and leg in Assalini's fracture-box, dressing the wounds at first with carbolic acid on Mr. Lister's plan, and at a later period—when suppuration has been fairly established, and the acute inflammation has subsided—with oakum. Langenbeck insists strongly on the advantages of the plaster-of-Paris splint in these cases, as in so many others, and I am informed by Dr. Patrick H. Watson that he has combined with the gypsum bandage a suspension rod similar to the one which he uses for excision of the knee (see p. 225), but without any splint. Professor Esmarch, of Kiel, has also adopted Dr. Watson's plan, and both surgeons have found the results very satisfactory.

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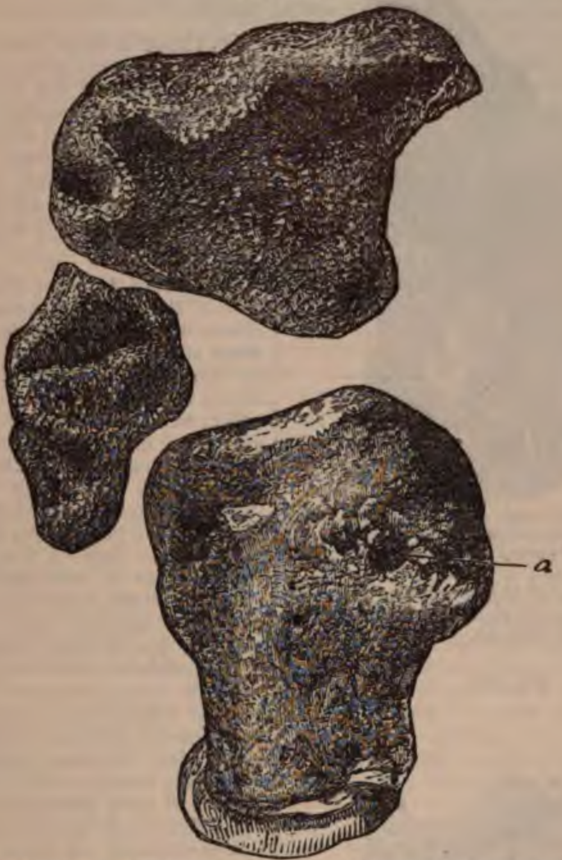
[1] Glasgow Medical Journal, vol. ii., p. 1.

[1] St. George's Hospital Reports, vol. iv.

Fig. 652.



Bones removed in excision of the ankle, showing the ends of the bones of the leg and the upper surface of the astragalus.

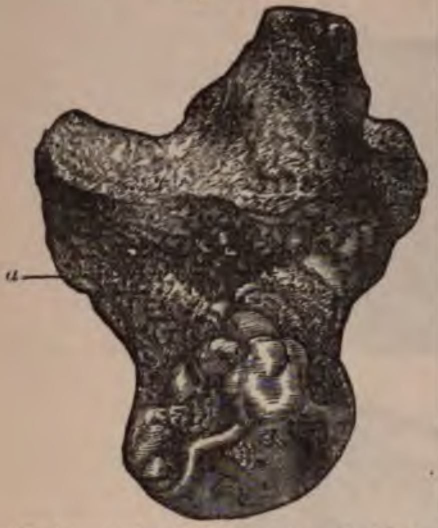
In cases of successful excision, the limb is very much superior in usefulness to any stump which can be formed, whether by Syme's or any other method of amputation.

One of these successful cases was exhibited at the Pathological Society in 1863. The excision had been performed, several years before, by Mr. Hancock. The foot was firmly ankylosed to the bones of the leg, and at a perfectly convenient angle. The shortening was but slight, and the man could walk almost as well as ever.

Fig. 654 was taken from a case in which I excised the ankle-joint in 1869. His present condition is thus reported by my friend, Dr. Nicholls, of Chelmsford, near whom he resides: "The operated leg is slightly shortened; all the wounds are healed; he walks, with the aid of a boot with irons, as much as half a mile, without inconvenience." In this instance the disease was abscess of the lower end of the tibia, bursting into the joint. Only the upper part of the astragalus was removed, that bone being quite healthy.

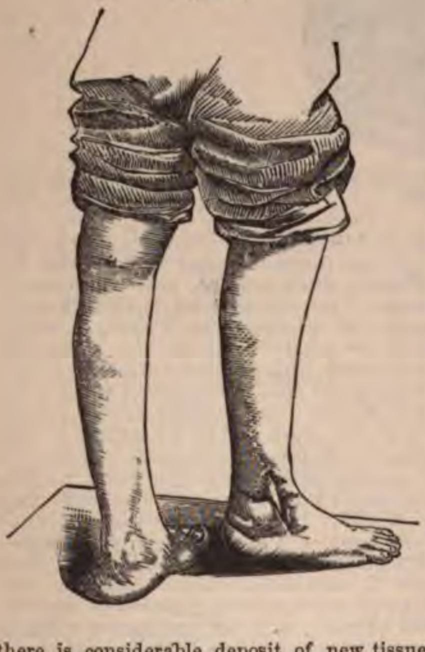
An interesting case is reported by Dr. Murney in the Dublin Quarterly Journal for February, 1870, in which the left ankle-joint had been completely excised eleven years before. The patient's state is thus described: "He is now 27 years of age, muscular and strong, has enjoyed uninterrupted good health since he left hospital; is active and fond of walking, and considers the left is stronger than the right limb; does not use a stick; in progression there is a slight halt, but no more than is frequently observed from a corn. This, to the ordinary observer, would be attributed to a slight *in-turning* of the toes of the left foot,* as when he walks the right foot is turned out, the left is placed straight. On examination, there is considerable deposit of new tissue between the bones which were cut. The foot is slightly extended. This makes the toes and anterior part almost of proper length, but the heel is 1½ in. higher than its fellow, which he remedies by placing a wedge-shaped piece of cork in the heel of his boot. The power of extension of the toes is as complete as in the opposite limb, and sensation is also perfect.

Fig. 653.



The lower surface of the astragalus. The letter *a* in this and the previous figure shows the pit made in the astragalus by the grasp of the lion-forceps.

Fig. 654.



On the other hand, cases occur in which the result appears good for the time, but the success turns out to have been only temporary; the wounds, after healing, break out again, and local, perhaps combined also with general, disease reappears. I do not know that this is more particularly the case after excision of the ankle-joint than after any other of these operations.

Excision of the bones of the foot.—In disease of the tarsal or metatarsal bones excision is often very successfully practised when the disease is limited to the os calcis behind, or to single bones of the metatarsus in front; but it is of more doubtful utility when the bones which are affected are those covered by the large common synovial membrane of the tarsus. These bones, both from their small size and from being portions of the same joint, are very liable to become involved in the same action, and thus it frequently happens that disease is only eradicated at one point to show itself some weeks afterwards at another, and the attempt to save the foot is often unsuccessful. But in favorable cases it ought to be made, since the operations involve little danger, and no confinement beyond what would be rendered necessary by the disease itself. Many surgeons prefer gouging out the whole carious cavity, leaving a shell formed of bone presumed to be healthy, and of the soft parts around; an operation sometimes dignified by the name of "subperiosteal resection," and described by M. Sédillot under the name of "évidement de l'os." The alleged advantages of this proceeding are, that the bone may be reproduced, and that the great tendons will be left in their natural attachments. I do not attribute very much importance to either of these considerations. No direct evidence, as far as I can discover, has been given that the natural bone will be reproduced after such gouging. I mean by "the natural bone," a bone which will fill up the place of the original bone, and have the same articulations; and by "direct evidence," the dissection of a foot in which this has taken place. The disadvantages are all of them summed up in the fact of the difficulty of being sure that the whole of the diseased bone has been removed. When the whole of the os calcis, of the astragalus, or of the first metatarsal bone, has been involved, except a small exterior portion of dubiously healthy bone, I have not scrupled to dissect out the entire bone without respect to the periosteum, and have seen no reason to repent having done so. The foot has been left in a very serviceable condition; and I much doubt whether the addition of a few detached pieces of bone to the cicatrix (which I believe would have been the entire result if the periosteum had been left behind) would have affected the usefulness of the foot in any way.

Excision of the os calcis is an operation which may often be practised with great advantage. Disease of the tarsus very commonly begins in the joint between the calcaneum and astragalus, and frequently spreads into the former bone; the affection of the latter being so superficial that the carious spot can be gouged away when the greater mass of disease has been removed. In these cases the central part of the calcaneum often perishes, leaving a large mass of necrosis enclosed in a thin-walled cavity of inflamed and softened bone. If now the whole bone, including this shell of softened bone, be removed, the patient makes a certain and speedy recovery with a useful foot; while if the loose portion be removed, and the shell scooped, he may, it is true, recover, and the heel may possibly be more firm, but the recovery is at least doubtful, and in the course of a tedious convalescence the health may give way, fresh disease be lighted up, and amputation become necessary.

Excision of the os calcis is thus performed: An incision is commenced at the inner edge of the tendo Achillis, and drawn horizontally forwards along the outer side of the foot, somewhat in front of the calcaneo-cuboid joint, which lies midway between the outer malleolus and the end of the fifth metatarsal bone. This incision should go down at once upon the bone, so that the tendon should be felt to snap as the incision is commenced. It should be as nearly as possible on a level with the upper border of the os calcis; a point which the surgeon can determine, if the dorsum of the foot is in a natural state, by feeling the pit in which the extensor brevis digitorum arises. Another incision is then to be drawn vertically across the sole, commencing near the anterior end of the former incision, and terminating at the outer border of the grooved, or internal, surface of the os calcis, beyond which point it should not extend, for fear of wounding the posterior tibial vessels. If more room be required, this vertical incision may be prolonged a little upwards, so as to form a +.[1] The bone being now denuded, by throwing back the flaps, the first point is to find, and lay open, the calcaneo-cuboid joint; and then the joints with the astragalus. The close connections between these two bones constitute the principal difficulty in the operation on the dead subject; but, as has been already stated, these joints will frequently be found to have been destroyed in cases of disease. The calcaneum having been separated thus from its bony connections by the free use of the knife, aided, if necessary, by the lever, lion-forceps, etc., the soft parts are next to be cleaned off its inner side with care, in order to avoid the vessels, and the bone will then come away. The flaps are to be closed lightly, with one or two points of wire-suture, over the large gap left by the excision.

This plan appears more convenient and less bloody than that recommended by Mr. Hancock and Mr. Guthrie, of making a flap from the heel and throwing it up, as done in Syme's amputation. Even if the diagnosis has been erroneous; if disease should become apparent in the astragalus or in the fore-part of the tarsus, when the bones are denuded, and so the surgeon should be led to amputate the foot, that operation could be easily accomplished by a slight extension of the incisions just described. In this way I have often removed the os calcis in a very short time, and without finding it necessary to tie a single artery. The filling up of so large a cavity is of course a rather tedious business: in most of the cases of which I have notes, recovery was not completed in less than three months; and probably the patient does not recover the power of putting the foot to the ground for another month or more. But when it is soundly healed, the foot is a very useful one; and I have seen children who could run, dance, etc., pretty nearly as well as with the natural foot.

M. Ollier describes an operation by which the os calcis can be removed subperiosteally without the division of any tendons, except the tendo Achillis. An angular flap is made by an incision running horizontally along the lower outer border of the bone, and vertically along the outer border of the tendo Achillis. Then the periosteum and the parts above it, including the peronei tendons, are peeled off the bone. Next the attachment of the tendo Achillis and the periosteum are detached from the tuberosity of the os calcis. Then the joints are opened, and the inside of the bone is cleaned, and so its removal is completed. I have only practised this operation on the dead subject. It seems to me feasible enough, and worthy of trial; but my experience of the ordinary operation has been so favorable, that I have been the less anxious to adopt this modification.

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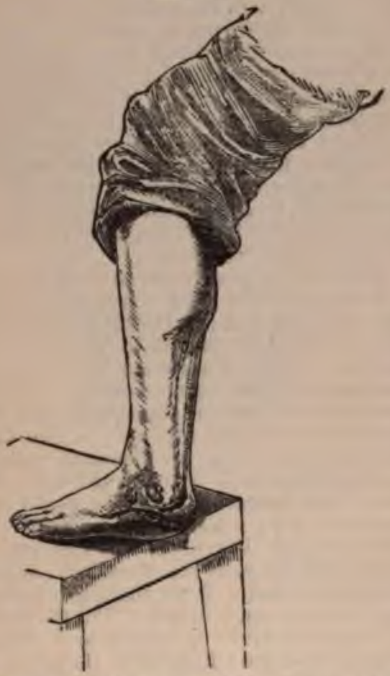
[1] I have always divided the tendons of the peroneus longus and brevis. They can, of course, be dissected out and held aside with a blunt hook, but I have not observed any bad effects from their division.

Fig. 655.



Drawing from the photograph of a patient in whom the os calcis, almost the whole astragalus, and a portion of the scaphoid bone, had been removed by Dr. Nicholls.

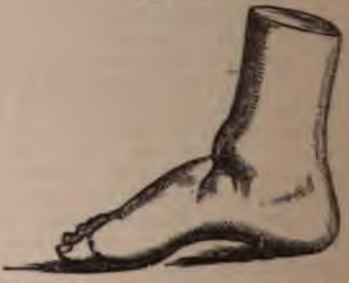
After recovery, the only mark of deformity in the foot is an elevation of the heel proportionate to the size of the bone removed. This can be judged of by fig. 655.

Even when the astragalus is also diseased, the foot may be perfectly useful after the removal of both the diseased bones. Thus at the Medico-Chirurgical Society of Edinburgh, December, 1869, Dr. Watson showed a cast taken recently from the foot of a boy on whom he performed excision of the astragalus and os calcis, in July. The cast showed how a dense mass of tissue occupied the gap resulting from the operation. The posterior portion of the arch of the foot being gone, of course the patient could not expect to retain the spring of the foot; but in spite of this, not only was walking easily effected, but the foot, as was seen, presented a most seemly appearance.[1]

A somewhat similar case occurred in the practice of Dr. Nicholls, of Chelmsford, the os calcis, almost the whole astragalus, and a portion of the scaphoid, having been removed in two operations. The patient can walk quite well and with a hardly perceptible limp; the appearance of the foot is shown in fig. 655.

Excision of the Astragalus.—The astragalus is easily removed by making a curved incision from one malleolus to the other, something like that made at the beginning of Syme's amputation. The ankle-joint is then to be laid freely open, and the whole upper part of the diseased bone thus exposed. Then the ligaments connecting it to the scaphoid are to be severed, and the bone is to be levered up, when the interosseous ligament connecting it with the os calcis will, if entire, be felt, and can be readily divided. All that is then necessary to complete the operation is to clean the back part of the bone, which should be done with care, in order to avoid injury to the tendons and vessels which lie near it. I have had several cases in children, and have seen one in an adult, in whom a very useful foot was left; one of these is represented above.

Fig. 656.



The foot after recovery from excision of the astragalus. In this case the scaphoid bone, which had become ankylosed to the astragalus, was also removed.

[Fig. 657.

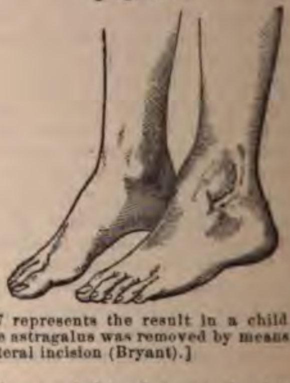


Fig. 657 represents the result in a child æt. 6, in whom the astragalus was removed by means of an external lateral incision (Bryant).]

The bone might, also, no doubt, be removed by two lateral incisions similar to those used in excision of the ankle. This would avoid the injury to the tendons and vessels incidental to the above method; but would be more laborious.

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[1] Edin. Med. Journ., Jan., 1870.

No formal directions are required for excising the other tarsal bones. The soft parts are to be thrown aside by crucial incisions, radiating from the sinuses which lead to the diseased bone, and the latter removed; care being taken in all cases where it is possible, to excise the whole bone with the articulating surfaces.

The metatarsal bone of the great toe is very often diseased; and from its large size the disease may go on in its substance for a long period without affecting any other bone. In such cases, after a sufficiently patient trial of the appropriate constitutional treatment, with rest, it is proper to expose the disease; and if this is found to include the greater part of the bone, then the best course is to remove the whole, with both its articular surfaces. This may be readily done by making an incision over the whole length of the bone, joined by shorter perpendicular cuts in front and behind, and thus turning back small rectangular flaps including the whole length of the bone. It is better to commence by severing it from the cuneiform bone, as in dividing it from the phalanx the plantar arch will most likely be wounded, and the bleeding may prove somewhat embarrassing; whereas if the artery be not divided till the bone is removed, there is no difficulty in tying it. No splint is required. The great toe sinks down somewhat towards the tarsus, but the foot is as useful in progression as before.

Should single metatarsal bones in the centre of the foot be diseased, it is better to gouge away the whole of the diseased part; or if the affection seems too extensive, to amputate the toe, and dissect out the metatarsal bone from the posterior end of the wound.

The above are all the operations of excision which it seems necessary to describe particularly. Dr. Humphry has removed the condyle of the jaw (see DISEASES OF JOINTS); and the same surgeon on one occasion excised a fractured portion of the patella; but the superficial position of these bones, and the rarity of the operations, render any formal description superfluous.

The operations on the upper and lower jaw have been described in connection with the surgery of that part of the body.

Total or partial resections of long bones.—When the entire thickness of a long bone is diseased, it may sometimes be advantageous to remove the diseased portion only. In this way portions of the ribs have been resected on account of caries, probably in order to avert the occurrence of pleuritic inflammation from the neighborhood of the diseased bone; an operation of some risk and very doubtful utility. Or portions of the shafts of the ulna, radius, tibia, or fibula, have been cut out, with a view of promoting the healing of ulcers that seemed otherwise incurable, or getting rid of an obstinate affection of the bone. Many operations for necrosis are also erroneously entitled resections of the bones, when they are really only extractions of sequestra; but in a few cases the necrosed shaft has been removed while yet connected to the living bone. Such operations, however, whether undertaken on account of caries or necrosis, too often result in failure. In cases of necrosis of a portion of the thickness of a bone, resection should very rarely be practised—perhaps we might say never, unless for the relief of inflammatory symptoms propagated from the diseased bone to neighboring organs. Nor, in cases of necrosis of the whole thickness of the shaft, is it usually advisable to operate until the old shaft has separated from the new bone. No special directions are needed for these operations. The chief point to be attended to is to keep as close to the bone as possible, in order to spare not merely the tendons, vessels, etc., which may lie in relation with the diseased bone, but also the periosteum; so that there may be as good a prospect as possible of the regeneration of the part removed.

Subperiosteal excision of the shafts of long bones.—In cases of diffuse periosteal abscess, it will occasionally happen that the whole thickness of the shaft of the bone perishes, and becomes separate, or separable with very trifling force, from the adjoining bone, whether at the epiphyseal lines, or at some part of the continuity of the diaphysis. In such cases the old practice was either to amputate, or to persevere in the expectant treatment until a sufficient periosteal deposit of bone had formed to restore the integrity of the shaft and support the muscular movements. I have in another essay[1] expressed my conviction that the latter plan of treatment should be abandoned, and that it is better, speaking generally, to remove a dead piece of bone whenever it is possible, without waiting for osseous reproduction. There are also cases, as I believe, where the subperiosteal resection of the whole shafts, or of large portions of the whole thickness of the shafts of the long bones, will much improve the patient's prospects of recovery, and in all probability obviate the necessity of amputation.

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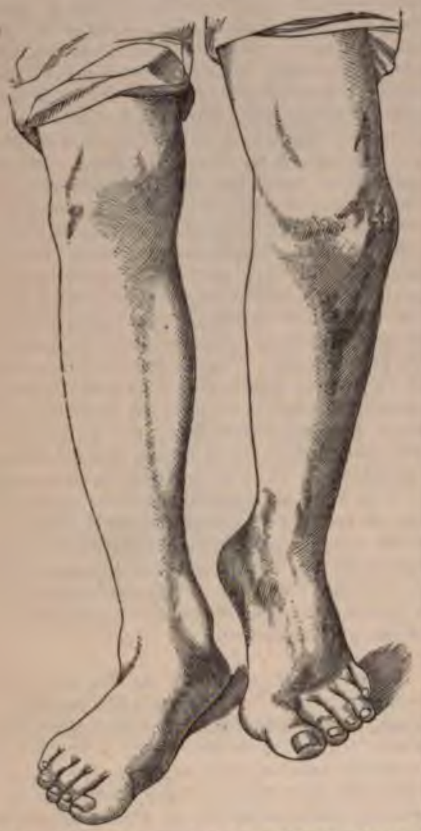
[1] DISEASES OF THE BONES, p. 156.

Fig. 658.



From a boy in whom the whole of the diaphysis of the tibia had been removed. To show the shape of the limb after reproduction of the bone, and the extent of the resulting shortening.

Many striking cases illustrative of the advantages of this operation have now been put on record. I may refer to a case of a boy, aged 10, in which I removed the whole diaphysis of the tibia, which had separated from both its epiphyses, one month after the commencement of acute periostitis; to another in which I removed a portion, 3½ inches in length, of the shaft of the femur about four months after the commencement of the disease, and before any periosteal bone had formed;[1] to another in which Mr. Joseph Bell, of Edinburgh, resected a still larger portion of the femur;[2] to a striking case by Dr. Cheever[3] of Boston, U. S., of resection not only of the whole diaphysis, but also of the lower epiphysis of the tibia, at the age of 13, where nine inches of bone were removed, the ligaments of the ankle-joint divided, and the articular end of the tibia formally dissected away from the fibula and astragalus, good motion resulting; and, finally, to three cases which may be found in M. Ollier's work, above referred to, under the care of Letenneur, Larghi, and Crus y Manso, in which the whole diaphysis of the tibia was successfully removed.

In all these cases, in which the whole thickness of the bone is removed for any considerable length, it appears to me, as far as I can discover, that shortening always ensues when the bone is solitary, as the femur; and almost, if not quite always, when it is the chief bone of the limb, as the tibia. The head of the fibula in these cases experiences a gradual displacement upwards. When it is the subordinate bone, as the fibula, or of equal rank, as one of the bones of the forearm, the other bone prevents the necessary approximation of the parts under muscular contraction, and the reproduced portions of the bone do not unite. Such, at least, has been my experience, but the cases are as yet too few to justify any confident general statement.

The operation is usually one of extreme facility. A very free incision should be made along the superficial aspect of the bone, and the periosteum separated by means of the handle of the scalpel, or other blunt instrument. This being done, a chain-saw is to be passed under the bone, and its divided ends seized with the lion-forceps and gently twisted. If they will come away from the epiphyseal lines, the operation is over; otherwise the chain-saw must be again applied at the limits of the separated periosteum. If the articular end is also to be removed, its ligaments must of course be divided. It is far more satisfactory to find the separation of the dead bone already complete, than to have to make the division of the dead bone from the living with the saw, though cases are on record in which the latter proceeding has proved successful.

Space hardly allows of a proper discussion as to the propriety of such operations as these under different circumstances. In all the instances referred to the operation succeeded. In one, in which I removed a portion only of the shaft of the tibia, it failed, and amputation became necessary, the patient recovering. But the cases have been far too few at present to enable us to judge as to the relative safety of this course and amputation. All that I will say here on the subject is, that in early life (and most, if not all, these cases occur in childhood), when the whole thickness of the shaft of the bone perishes in consequence of acute periosteal abscess, and is separable from the neighboring portions, subperiosteal exci-

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[1] Surgical Treatment of Children's Diseases, 2d ed., pp. 391, 395.

[2] Brit. Med. Journ., May 2, 1868.

[3] Surgical Cases, by D. W. Cheever, M.D., p. 16; Boston, 1869.

Fig. 659.

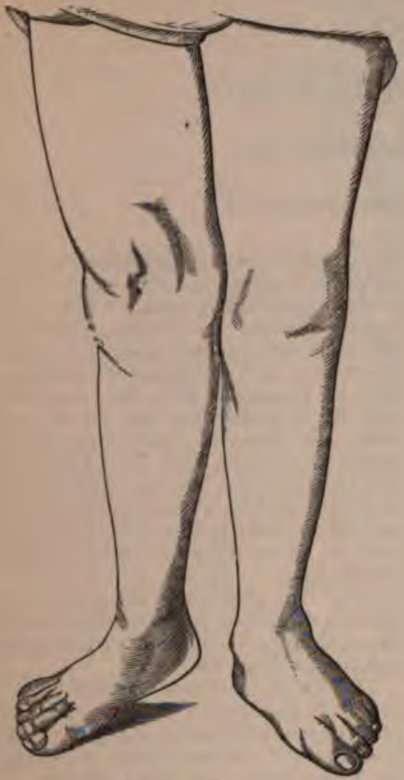
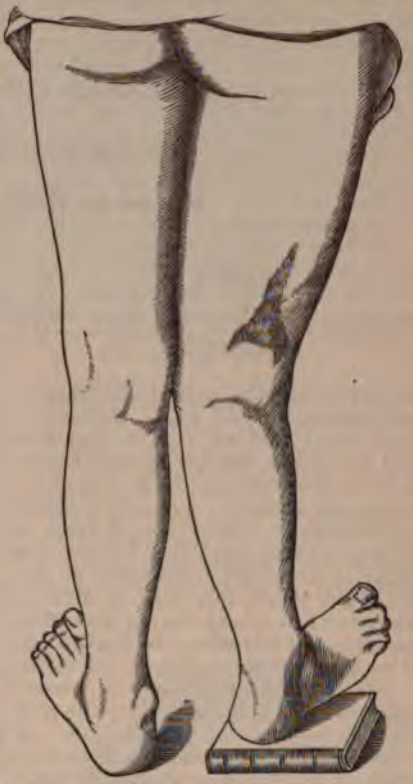


Fig. 660.



From a case in which three inches and a half of the shaft of the femur had been removed subperiosteally. The knee became ankylosed from the extension of suppuration into the joint. Fig. 659 shows the amount of the resulting shortening, which is confined entirely to the femur. The cicatrix on the inner side is the mark of an abscess. The posterior view of the limb shows the position of the wound from which the bone had been extracted, and the deformity produced by the ankylosis.

sion appears to me to be indicated, and should be performed at the earliest possible period. Many of these cases terminate in the most gratifying manner; and a patient who would otherwise have been condemned to amputation, or have lost his life by pyæmia, rapidly recovers from the profound surgical fever which accompanies this complaint, and regains a very useful, though somewhat shortened limb. In less acute cases, where the amount of bone which has perished is smaller, and the surgical fever does not run so high, the expectant treatment is certainly justifiable, and may often be advisable.

DISEASES OF THE JOINTS.

BY ATHOL A. JOHNSTONE, ESQ.

Revised by E. H. BRADFORD, M.D.

PART I.

DISEASES COMMON TO ALL THE JOINTS.

IN estimating the nature and importance of diseases of the joints, we have to bear in mind that we have to deal with varied structures, distinct in their formation, their functions, and their pathology, but all so far united for a special purpose that disturbance of any one of them is sufficient to derange the harmonious working of the whole. The study of diseases of the joints, therefore, involves to a greater or less extent that of the affections of the *osseous system*, the foundation, as it were, of the articulations; of *cartilage*, *fibro-cartilage*, or *membrane*, interposed between the bones to play the part of the buffers in the railway-train; of *fibrous tissue* or *ligaments*, the coupling-chains; of *synovial membranes* with their *synovia*, the lubricating boxes and grease by which the friction is diminished; as well as of *connective* and *adipose tissues*, which serve as packing material to fill up the hollows. External to the joints, moreover, but still playing an important part in their mechanism, are various muscles with their tendons, as well as synovial bursæ, the pathological conditions of which in their relation to the joints cannot be entirely omitted or passed over.

It is only since the investigation of the diseases of the joints has been pursued in relation to their structural origin (for which we are mainly indebted to the acute intellect and philosophical spirit of Sir B. Brodie), that any precision of diagnosis has been arrived at, any really physiological system of treatment been adopted. The diseases of the joints are no longer lumped together under the vague denomination of "white swelling," but referred, with more or less certainty, to the tissues in which they commenced, and connected with the pathological changes which those tissues are found to have undergone. It must, however, be admitted that when disease has advanced to a certain stage, so many of these structures are likely to be involved, that an accurate allotment of the symptoms to their respective sources would be useless even if it were possible; so that, practically, we have often to disregard minute anatomical distinctions, and consider the case mainly as regards its severity and probable termination. It may be remarked, too, that the separation of joint-diseases into those which affect the synovial membranes or ligaments, the bones, and the cartilages, is more obvious and more practically useful in adults, in whom these structures have arrived at their full growth, than in children, in whom they are still in process of development. As Mr. Hilton justly observes, "in childhood the separate and distinct disease of the articular structures can seldom be recognized with any useful precision during life."[1]

The limits assigned to this essay are evidently insufficient to allow of any complete or comprehensive study of these varied diseases; no more than a sketch can be attempted; but that sketch, it is hoped, may be found sufficient for all practical purposes.

Anatomically all joints are not alike, being divided into the comparatively simple *synarthrodial* articulations, or those devoid of a synovial membrane, and the more complicated *diarthrodial*, in which a synovial membrane exists. Pathologically a similar distinction may to a certain extent be drawn, and the affections of the diarthrodial articulations may conveniently be separated from those of the synarthrodial, which will receive such notice as may be considered necessary in the latter part of the essay.

DISEASES OF THE SYNOVIAL MEMBRANES—SYNOVITIS.

Synovial membranes are liable to inflammation, forming what is usually, though not perhaps very correctly, termed *synovitis*.

The inflammation which attacks a synovial membrane may be of the ordinary character, or it may be modified by certain constitutional conditions. Common synovitis occurs, in many cases, as a local affection from the direct irritation of mechanical injury, or results from undue exercise and exposure of the joint to atmospheric influences; it may also be induced by disease which has involved the adjoining tissues. This form of inflammation is generally confined to a single articulation.

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[1] See also Holmes, Surgical Diseases of Children, p. 411. [For a different opinion, see Volkmann, die Fungöse Gelenkentzündungen, Klinische Vorträge, xv., 168, 169.]

The constitutional conditions which modify the character of the inflammation may be more or less permanent, and even hereditary. Sometimes we find the patient presenting evident marks of *scrofula*, and the local disease sharing in the peculiarities of that affection; in other cases, and principally in the poorer classes, who are ill-clad and unduly exposed to variations of temperature, the *rheumatic* diathesis is apt to prevail; whilst in those who live luxuriously, the local inflammation may be preceded or accompanied by various symptoms of disordered digestion, indicating the presence of an unusual quantity of uric acid in the system, or the existence of the *gouty* diathesis. The constitutional modifications, on the other hand, may result from causes which are obviously temporary. A peculiar form of synovial inflammation, for instance, may occur unexpectedly after parturition, or following some operation, in those in fact who are suffering from what is termed *pyæmia;* or it may take place suddenly during the progress of urethral discharge, when it is distinguished by the name of *gonorrhœal rheumatism;* or, finally, it may manifest itself during the existence of *venereal* poisoning. In all these modifications of inflammation, it may be remarked, there is a considerable chance of the topical disease manifesting itself in more than one articulation.

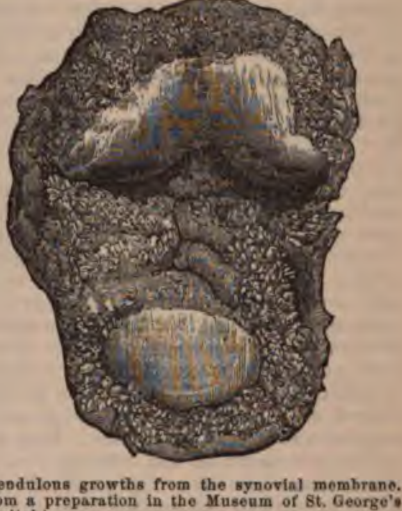
It will be convenient to commence with a description of the *simple* form of inflammation of a synovial membrane, and its consequences, and afterwards to notice briefly the peculiarities presented by synovitis when *scrofulous*, *rheumatic*, or *gouty; pyæmic*, *gonorrhœal*, or *syphilitic*.

Acute synovitis.—Synovitis may be acute or chronic. Acute synovitis, arising in the membrane itself from the causes already alluded to, occurs more frequently in adults than at an earlier period of life, in males than in females.

Pathological anatomy.—The simplest changes which result from inflammatory action consist in increased vascularity of the membrane, especially of its plicæ vasculosæ, followed by increase in the amount of the synovia, and some alteration in its healthy composition. A little later, we find the products of inflammation either effused into the synovial cavity, mingling with and usurping the place of the normal secretion, or situated in the texture of the membrane and in the immediately contiguous tissues. The effusion into the joint-cavity may consist of serum, mixed with shreds of synovial epithelium, and a variable amount of organizable lymph, giving rise to false membranes connected with the walls of the cavity or floating in the secretion; some of the coloring constituents of the blood may also be present. In a large number of cases the inflammation is arrested before much mischief occurs; the vascularity of the membrane diminishes, the effused fluids are absorbed more or less completely, and the joint is restored to its original condition; or it may be left more distended than natural, and liable to fresh effusion; or a certain amount of thickening and loss of mobility may remain permanently.

In other cases, however, further changes occur within the joint, giving rise to villous or fringed processes, extending, perhaps, over the cartilages, which may still be found beneath them. At the same time a similar action takes place on the outer side of the membrane, increasing the amount of thickening and consolidation of the capsule. If the inflammatory action still proceeds unchecked, the fluid effused into the joint becomes turbid, and pus is formed, at first scantily, but afterwards in larger quantities; the other structures entering into the composition of the joint become involved in the diseased action; the articular cartilages are

Fig. 661.



Pendulous growths from the synovial membrane. (From a preparation in the Museum of St. George's Hospital.)

affected, ulcerous excavations extend through their substance, and the articular extremities of the bones participate to a greater or less extent in the disorganizing process. The parts outside the joint-cavity undergo similar changes; degeneration takes place in their newly-formed materials, and abscesses arise there, communicating with the joint by ulceration extending through the capsule, or making their way to the surface by means of sinuses. The ligamentous structures become thickened or softened, or otherwise altered, so as, in some instances, to be no longer capable of holding together the bones, which may thus become completely or incompletely dislocated.

Symptoms.—The leading symptoms are those of inflammation generally, varying in degree with the amount of synovitis present, with the cause inducing it, with the particular constitutional condition, and with the individual joint affected. The amount of inflammatory fever depends upon the character and extent of the synovitis, and the importance of the articulation, being generally most marked when the hip-joint is the seat of the disease. Locally, we have *pain*, usually of considerable amount, increased by any movement of the part, and often characterized by a feeling of distension. It may be noticed also that the pain in articular inflammations, as in those of some other organs, is not always referred to the region in which the disease actually exists. In diseased hip, for instance, the suffering may be experienced mainly in the knee, giving rise occasionally to mistakes on the part of the careless observer. There is *swelling*, varying with the amount of effusion into and round the joint, and taking the shape not of the articular extremities of the bones, but of the distended synovial capsule, modified by the degree of resistance afforded by the surrounding structures. *Fluctuation*, at least in the more superficial joints, is usually distinct, becoming less so if the disease is prolonged and the inflammatory products acquire a more solid character. *Heat* and *redness* are more or less evident, according to the situation of the joint affected, its proximity to the surface, and the degree in which the tissues external to the synovial membranes are involved. The *position* which is unconsciously assumed in acute articular inflammation is often characteristic of the affection and of the particular joint implicated. To alleviate suffering, by securing rest, the limb becomes more or less rigidly fixed by involuntary contraction of the muscles in its neighborhood, but in addition to this rigidity, there is a strong tendency for the joint to become flexed, and for this flexion steadily, though gradually, to increase unless arrested by the surgeon. It has been supposed that the rigidity and flexion are due to over-distension of the joint-cavity by fluid; but the ease with which the joint can be moved, and the increased flexion relieved when chloroform is administered, points rather to undue muscular contraction. The most rational explanation appears to be that given by Mr. Hilton, in his valuable work On Rest, viz., "that the irritated or inflamed condition of the interior of the joint (say the knee-joint), involving the whole of the *articular nerves*, excites a corresponding condition of irritation in the same nervous trunks which supply both sets of muscles, extensors, and flexors; but that the flexors, by virtue of their superior strength, compel the limb to obey *them*, and so force the joint into its *flexed condition*."[1] At any rate the effect produced, that is, the position assumed by the limb, is practically of great importance, for it is capable of maintaining or aggravating the disease at the time, as well as of giving rise ultimately to great embarrassment in the event of anchylosis occurring.

In the majority of cases of uncomplicated synovitis, the inflammation speedily subsides, the fluid is absorbed, and the part returns to its normal condition. In others, however, the joint remains somewhat swollen, the synovial membrane is thickened, and the mobility of the part diminished, whilst the patient is left very liable to relapse from exposure to any of the exciting causes of synovitis. Or the acute symptoms may simply diminish, and without any interval of restoration to health the disease may assume the chronic form to be subsequently described. In a certain number of cases, unfortunately, the inflammation, instead of subsiding, increases in severity, and the disease is no longer confined to the synovial membrane, the cartilages and other structures becoming involved, in the manner to be more minutely described hereafter. Such extension is marked by fresh and excruciating suffering, by painful "jumping" of the limb, as well as by crepitus on moving the joint, as the cartilages become destroyed, and is followed or attended in a large proportion of cases by suppuration.

Acute articular abscess.—Suppuration in a joint, however, occasionally occurs also *directly* as a consequence of acute synovitis, the effect frequently of some injury, or, in children especially, as the result of acute inflammation supervening on chronic disease of the joint. In this acute form of joint-disease, whether we assign the synovial membrane proper, or some other of the varied textures with which it is more or less blended, as the starting-point of the disease, we may *suspect* the formation of matter, if the inflammation run very high; if one or more rigors occur, followed by exacerbation of the pain and general suffering; and if the tumefaction increase and take on a more decidedly phlegmonous character which extends to the surface. [There seems to be some doubt as to the fact that in chronic joint affections suppuration is usually preceded by a febrile onset. König states that after a series of careful thermometric observations he is convinced that suppuration is always preceded in chronic arthritis by fever. Schede, however, reports that the temperature curve is of no value in fungous arthritis.[1]] The constitutional disturbance will now be great, the pulse rapid, and the character of the fever will be altered, assuming somewhat of a typhoid form. When suppuration has occurred within the joint, and the case progresses unfavorably, the parts around become speedily affected. Abscesses are formed in the surrounding areolar tissue; at first, perhaps, separate from, but soon communicating with the articular cavity. The fibrous tissues become softened and yield, the skin gets implicated, and openings form communicating with the joint, and discharging a more or less unhealthy pus. When much disorganization has taken place within the joint, the most favorable issue to which we can look forward is discharge of the matter, and union of the opposed articular surfaces. The health may now improve. The swelling subsides, the discharge diminishes, and at last ceases, the sinuses heal up, the joint-cavity is obliterated, being filled with newly-formed connective tissue, and the limb is stiffened or completely anchylosed. If, however, the constitutional powers give way, the patient may be worn down by the severity of the pain and profuse discharge; the removal of the source of irritation, by excision or amputation, becomes necessary, or where this is impracticable, life is at last extinguished.

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[1] Hilton, On the Therapeutic Influence of Rest, p. 156.

Chronic synovitis may be simply inflammatory in its character, though it occurs more commonly perhaps as a modification of the inflammatory process, dependent on certain constitutional cachexiæ, such as scrofula, syphilis, gout, or rheumatism. In some cases the distinctive characters of each of these varieties are clear and well defined; and no difficulty is experienced in assigning the affection to its appropriate place. In others, however, the boundary-line is not always drawn with precision; and the surgeon finds in these diseases, as in most others, that the definite descriptions necessitated in books are not always borne out in practice. Just as acute disease melts by insensible gradations into the chronic, so the constitutional modifications of inflammation are often imperfectly or scarcely marked. At the bedside of the patient, the surgeon must work out for himself many details; and every case will still offer some special employment for his intellectual investigation. The author can only point out, as it were, the leading types; he who attempts more bewilders the reader instead of assisting him.

Acute inflammation of the synovial membrane, imperfectly treated, may by degrees assume the chronic form; or commencing without any great activity in its symptoms, the inflammation may pass into a chronic condition; in the latter case, however, the probabilities are very much in favor of the existence of some constitutional taint. The joint is sometimes much distended with fluid; and the synovial membrane itself, in protracted cases, loses more or less of its natural structure, is over-vascular, and permanently thickened, or converted into a firm and gristly substance. The disease may gradually yield, or it may remain stationary in this condition for a considerable time, and then, under the influence of fresh inflammation, the joint may ultimately become totally disorganized.

The symptoms are much the same as in the acute form of disease, and far less severe in their character. The constitutional disturbance is comparatively little felt. There is swelling, sometimes to a considerable extent, more or less pain is experienced, and the movements of the joint are often very greatly impaired. In some instances a peculiar crepitus or crackling is felt, or a sensation is communicated to the hand as if a number of loose bodies existed in the joint, depending, perhaps, on effusion of plastic material into the cavity, similar to that noticed in inflammation of the bursæ and tendinous sheaths. The simple form of chronic synovitis—the form, that is, not connected with any constitutional taint—usually terminates favourably unless neglected, as is occasionally seen in the laboring classes, when attack after attack may occur till at last the joint is destroyed, or life itself sacrificed. In cases, too, of long standing, where great induration of the soft tissues has occurred, complete restoration to a healthy condition becomes at best difficult, and relapses into a state of sub-acute inflammation are of frequent occurrence.

[[1] London Med. Record, 1878, p. 221. From Berl. Klin. Wochenschrift.]

Treatment of acute synovitis.—The treatment to be adopted is partly general, partly local. If the inflammation runs very high, and the patient is strong and plethoric, it may be necessary to take blood from the arm; at any rate, a brisk mercurial purgative, followed by salines, with antimony, and perhaps with colchicum, will be advisable, or in some cases it may be expedient to place the system rapidly, but for a short time, under the influence of mercury. Where the patient is less robust, any bloodletting had recourse to should be local; and in all cases, though it will be desirable to keep the liver acting by combining taraxacum with the saline medicines, or by administering occasionally some preparation of mercury, violent purgatives should be avoided, on account of the disturbance to the limb which they necessitate.

The primary and essential condition of the local treatment is complete *repose.* When the inflammation is of moderate extent, mere rest in bed, with the joint supported by a partially distended air- or water-cushion, will be sufficient. Where the inflammation is severe, and danger of permanent mischief threatens, more decided mechanical support is required. The position to be adopted varies with the individual joint, but in all cases must be that which keeps no ligament, and no part of the synovial membrane, on the stretch, and which, in the event of anchylosis occurring, will allow the limb to be used to the greatest advantage. Supposing the articulation to have already assumed an improper position, it is better to put it right *at once*, even if the existing inflammation is acute; for in unnatural positions the different parts of the joint are kept in a state of undue pressure or of undue tension, either of which interferes with healthy nutrition, and so opposes the curative process. Under the influence of chloroform [or ether], the replacement can, at this time, be readily effected.[1] [The experience of Bonnet appears to demonstrate the safety of the procedure of forcible straightening, while inflammation is present. (Maladies Articulaires.)[2]] The splint used should be well adapted to the limb, and be of *sufficient length;* in many cases it is absurdly short, giving no real rest to the joint, and allowing the weight of the parts below to drag upon the ligaments, and tend to produce deformity. In disease of the knee-joint, for instance, to give effectual support, the splint should extend very far up the thigh, and be furnished below with a foot-piece, to prevent the tendency of the foot to fall outwards or inwards, and so produce a corresponding twist of the affected articulation. The points here insisted upon are, of course, applicable not merely to cases of synovitis, but of all diseases of the joints, in which absolute rest is demanded.

Local depletion may be required to an extent determined by the acuteness of the inflammation and the vigor of the patient. If leeches are applied, it must be remembered that they act not merely by the abstraction of blood they give rise to, but also as derivatives, in consequence of the irritation produced by the bites. The application of leeches immediately over a *superficial* joint may tend, consequently, to increase the inflammation instead of diminishing it. In acute synovitis of such a joint as the knee, therefore, it is better to apply leeches at some short distance *above* the joint, so as to empty the distended vessels below. The same observations would, of course, apply, should cupping be employed instead of leeches.

After, or in many cases in place of, the local depletion, various emollient applications may be used. As a general rule, warm fomentations and poultices are the most successful in relieving pain. Occasionally, however, cold is more grateful to the patient. Whichever is employed, uniformity of temperature is much to be desired; the joint should not be exposed to frequent changes, but the applications should be maintained constantly at or near the same standard. It is on this principle that wrapping the joint in cotton wool, or covering it with ointments which exclude the air, is often of service. If cold be applied, it may be used as directed by Dr. Esmarch,[1] in the form of ice contained in bags of vulcanized India-rubber (far preferable for many reasons to bladders), separated from the limb by a piece of lint. If this prove too heavy, a simple apparatus may be contrived, by suspending, at a suitable angle, from the cradle placed over the affected limb, a bottle containing cold water, in which a few threads are partially immersed, with their ends hanging out of the mouth of the bottle; these, by capillary attraction, will keep up a constant drip upon a piece of lint covering the inflamed joint, and the supply of fluid may be so regulated, by varying the number of threads, as just to compensate for the loss by evaporation, and prevent the rag from ever getting dry. Such an arrangement I frequently used with advantage at the Hospital for Sick Children, both in cases where acute inflammation already existed, and in others where its occurrence might be anticipated in consequence of operations. The cold should be maintained without intermission, as long as any abnormal increase of temperature exists, provided it appears grateful to the feeling of the patient.

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[1] As Mr. Holmes Coote, at page 85 of his work On Joint Diseases, has quoted these remarks for the purpose of adding, "To this practice I most strongly demur," I may be allowed to cite the very judicious and forcible observations of Mr. Hilton respecting the mischievous and destructive effect he has over and over again seen produced by allowing the joint to assume or retain the fixed and flexed position induced by involuntary muscular contraction, "resulting not seldom, I may say, from procrastination, or inexcusable want of courage on the part of the surgeon to rectify it, or from his yielding too easily to the importunities of the patient or his friends, in order to avoid giving pain to the patient. From the time when the limb begins to be flexed starts the mischief, which by-and-by cannot be controlled." And again, after relating two cases in which amputation had to be performed: "It seems to me that it is a great mistake not to correct it *at once* when they see an inflamed knee or other joint beginning to be contracted or flexed. I believe their duty is to prevent the increase of the flexion, and so avert the condition which, at all events, led to the necessity for amputation in these two cases."—Hilton, On the Therapeutic Influence of Rest, pp. 161–3. I need not say how heartily I concur in these remarks, in which, it may be noticed, the very words employed in the text about correcting the improper position "at once" are adopted by Mr. Hilton.

[[2] See also Bauer, Lectures on Orthopædic Surgery.]

Treatment of acute abscess of joints.—If there is reason to believe that acute inflammation of the synovial membrane has proceeded rapidly to suppuration, the fact may be verified, at least in the more superficial joints, by the introduction of a needle-trocar. Supposing matter to be found, if situated outside the joint an early incision may prevent the pus making its way into the joint-cavity; and if inside the articulation, the urgency of the symptoms will seldom allow of much delay. It is better, therefore, when the situation of the joint admits of it, to evacuate the matter as early as possible by a free incision, which may be made under the protection of lint steeped in carbolic oil, and the wound afterwards dressed on the antiseptic principle, as practised by Mr. Lister.

[*Incision and drainage of the joints.*—The advantages of the antiseptic system in surgery is well demonstrated in the change thereby produced in the treatment of joints with effusion, or inflamed joints. Bonnet has stated that suppuration always follows an opening in a large joint. At the present time experts in antiseptic surgery incise joints (with or without suppuration), and the most remarkable success is reported. Mr. Lister has recently treated a simple fracture of the patella by opening the knee-joint, inserting a drainage-tube, and wiring the fragments. The patient recovered perfectly in eight weeks, with perfect motion at the joint. Scriba, of Baden, recommends incision and drainage of the knee-joint in chronic serous inflammation, in chronic disease of the knee-joint with granulation, with effusion, and no disease of the bone, in acute purulent affections of the joint, and in acute serous affections where the pain is severe and continued. He reports six cases where incision of the knee-joint was done antiseptically, and all recovered perfectly. Heinecke reports ten cases where the joint was incised and washed out. In two the operation was done for suppuration caused by a wound. In seven cases the result was a cure with perfect motion. In three suppurative knee-joints (two complicated by disease of the bone) there was only limited motion on recovery. Of the seven other cases one was an acute serous inflammation, one hydrops articuli, one sanguineous effusion, three were punctured wounds of the joint, one was removal of a loose cartilage. Schüller reports two cases of antiseptic incision and drainage of the knee-joint. Recovery followed. In the other the suppuration at the knee-joint followed an attack of erysipelas, and the patient died after the incision. Rinne reports eleven cases of knee-joint affections tapped with a trocar and washed with a three per cent. solution of carbolic acid. In five of these no reaction followed; in four there was slight fever; nine were completely cured; one died of tuberculosis; one was improved, but did not gain perfect motion. Ranke reported seventeen cases of open wounds of the larger joints, treated antiseptically; fourteen recovered with motion at the joints. In three the result was anchylosis, but in these antiseptic treatment was not begun until after suppuration had been established. These figures show remarkable success, and leave the impression that incision into the joint is an almost harmless procedure. In the practice of the editor, however, a death from shock followed twelve hours after incision into the knee-joint. The operation was done with the most thorough antiseptic details, for suppurative disease of the knee-joint; but the patient was a child three years old, unable to bear operative interference of any sort.[1]]

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[1] On the Use of Cold in Surgery, New Syd. Soc., 1861.

[[1] Scriba, Berlin K. Wochensch., Aug. 6, 1877; Heinecke, Deutsche Zeitschr. f. Chirurgie, 1878, 10th Bd., p. 296; Schüller, Deutsche Med. Woch., Nov. 24, 1877; Rinne, Centralblatt f. Chir., Dec. 8, 1877; Ranke, Ibid., 29, p. 480, 1878; Schmidt's Jahrbücher,

The opening in such cases is usually attended with marked relief; but fresh incisions may afterwards be made, or a drainage-tube introduced if any obstacle to the exit of pus shows itself. During this time the most perfect rest must be observed, and the limb maintained accurately in position by splints of sufficient length, moulded, if necessary, to the requisite form. Great attention must also be paid to the general health, and the strength supported as the activity of the inflammatory fever subsides.

If the matter within the joint decomposes without escaping freely, absorption of some of its putrid constituents may occur, showing itself by the irritative or typhoid character of the fever. In many cases life is now so evidently at stake, that removal of the diseased part either by amputation of the limb, or, in exceptional instances, by excision of the joint, becomes imperatively called for. In other cases, after providing as far as possible for the free evacuation of the pus, weak iodine injections may be used, not merely to modify the action of the secreting membrane, but also to improve the character of the matter. With care and attention on the part both of the surgeon and the patient, acute suppuration of joints from synovitis may often be expected to terminate favorably, especially in children; but as more or less stiffness of the joint must be expected, special attention should be paid from the first to the position of the limb, instead of waiting, as is sometimes done, till ankylosis has taken place, to remedy the deformity which has been allowed gradually to arise.

Treatment of sub-acute and chronic synovitis.—Instead of giving rise to the formation of abscess, the acute inflammatory symptoms usually subside. As this change occurs, the antiphlogistic treatment is modified; some blood may still be abstracted by leeches applied directly over the part, and cooling applications may be used, or counter-irritation may be had recourse to, in the form of blisters, to produce a discharge of serum from the vessels of the skin. Blisters may be used earlier in inflammation of the deeper-seated joints than where the superficial articulations are implicated; for in the latter the small amount of intervening tissues allows the irritating action to be propagated to such an extent as sensibly to affect the synovial surface, acute inflammation of which may be again excited under the influence of too severe or too early a stimulus. In synovitis, therefore, of the superficial joints, blisters should not be applied too hastily, and when used may be placed some little distance above the inflamed spot; it is better also to employ a succession of "flying" blisters rather than to keep *one* open by irritating applications. Following the blisters, or in place of them, various stimulating liniments may be used, or the parts painted with concentrated tincture of iodine. As the inflammatory symptoms subside, in those cases especially where some thickening of the membrane has occurred, we combine a moderate amount of compression with our support of the part; this may be done by applying alternate layers of bandage and adhesive plaster with or without camphorated mercurial cerate next the skin, in the way described as "Scott's bandage." [The most convenient method of employing compression in joint effusions is by means of a rubber bandage.[1] (Surgical uses of the Strong Elastic Bandage, by H. A. Martin, M.D.) Less efficient for this purpose are flannel bandages, and the bandaging of dry compressed sponge, which if bound tightly around the joint, will expand when wet and exert compression on the joint.[2] Another way has been suggested, viz., to use compression by means of rubber bags placed around the limb, and then filled with water.] Sometimes the bandage is starched, but care should then be taken, if any fresh outburst of inflammation occurs, that the bandage can be promptly removed, if necessary, by the patient. In some cases it is useful to employ splints made of cow-hide, softened in warm vinegar, moulded to the form of the joint, and fastened on the limb after having been lined with chamois leather. Many similar contrivances will probably suggest themselves to the surgeon's mind.

If rest be a primary necessity in the acuter stages of inflammation, a time comes at last when this has to be discontinued, and passive motion of the joint substituted in its place; but the exact time when this change is to be made, often requires great judgment and discrimination. The mere presence of pain on motion is not always decisive of the necessity of rest, for in some cases, after long confinement, pain and aching are actually relieved by free and even strong movements.

A distinguished artist, for instance, came under my care for disease of the right wrist-joint following exposure to cold and wet.

1877, Bd. 174, p. 268; Lucas-Championnière, Gaz. Med. de Strasbourg, Sept. 1, 1877; Lancet, 1875, vol. ii., 311; Brit. Med. Journ., March 31, 1877; Edinburgh Med. Journal, Sept., p. 193, 1875.]

[1] [Transactions Am. Med. Assoc., 1877.]

[2] [See also Cohn, Allg. Med. Cent. Zeit., Dec. 5, 1877, p. 1211.]

The inflammation had been severe, and the joint had been kept at perfect rest for several months, but still great aching and pain were complained of, the part was puffy, stiff, and sensitive, though not warmer than natural, and the patient in despair of ever again being able to follow his profession. With some degree of caution I removed the splints and employed passive motion, gradually increased in force, strong friction to the part, and localized galvanism to the individual muscles of the forearm, which had become rigid from confinement, like the joint itself. The pain subsided under this change of treatment, and by degrees perfect motion was regained, so that the artist has been enabled to resume his profession with no impairment of his technical skill.

Perhaps the best indications for substituting motion for rest in those cases in which pain continues severe after active disease has subsided, are the comparative low temperature of the joint, and the tendency of the integuments to become dusky and puffy.

[M. Verneuil has recently strongly protested against the use of passive motion as a preventive to ankylosis. "Ankylophobia," as he terms it, has no real basis. Ankylosis results from the processes of inflammation, and rest complete and absolute is the best antiphlogistic; no motion should be allowed until the patient is able to exercise the limb, and all that can be gained will be gained in that way. He does not deny that cases are met where *brisement forcé* is of use, but believes that these do not belong to joint affections proper, but to periarticular troubles and the result of previous inflammation. The use of passive motion to prevent ankylosis in the course of inflammatory troubles, as recommended by Bonnet, he believes to be injurious.

The efficacy of massage, which includes passive motion, in sprains of the joints cannot be questioned, and the method of its application has risen from the level of empiricism to that of a well-established rational therapeutic agent in the treatment of the periarticular changes which follow or accompany sprains. Its employment has been advocated in acute traumatic synovitis, chronic synovitis, hydrops articuli, chronic rheumatic arthritis, and in the sequelæ of acute and chronic inflammation of the joints. It is claimed that massage is useful in all the forms of joint trouble where a cure may be expected; and that by its employment a recovery can be more quickly gained than without it.[1]]

The treatment sketched out has been that proposed for disease of the synovial membrane itself; the treatment of those cases in which the bones and cartilages become involved will be alluded to subsequently, in the sections treating of diseases of those tissues.

Dropsy of joints.—We occasionally meet with cases in which the synovial membranes are very greatly distended with fluid, whilst few or no other symptoms of inflammation are present. The affection, therefore, has been compared to dropsy of serous membranes, especially to that of the tunica vaginalis testis forming hydrocele, and has received the special name of *hydrops articuli*. I have placed it, however, immediately after ordinary synovitis, because in almost all the cases where an opportunity has been afforded of examining the joint, the lining membrane has been found somewhat thickened and unusually vascular, especially in the situation of its vascular processes. The fluid differs from ordinary synovia, being transparent and of a yellowish color, but presenting no appearance of "threads," though it coagulates on the application of heat; in fact, it closely resembles the fluid met with in ascites or in hydrocele. All synovial membranes are not equally subject to dropsy, which usually affects those of considerable extent, and in which the secretion is naturally abundant. It is most frequently found in the knee, sometimes in the elbow, very seldom in any other articulation. Hydrops articuli is scarcely ever a primary affection. It may follow an acute attack of synovitis, and is apt to recur in persons of weak and irritable constitutions, when once the membrane has been over-distended. In such persons the immediate attack may be induced by exposure to cold or very slight violence, or even by some less obvious constitutional disturbance.

The effusion takes place very rapidly, and forms a tumor, whose limits are those of the synovial capsule. Its character may generally be easily recognized by the shape of the swelling and its ready fluctuation. There may be some slight symptoms of inflammation present; but usually, though the limb is somewhat stiff; it may be used with scarcely any pain, even from the first, and the parts external to the capsule show no traces of redness or œdema. From thickening of the joint due to effusion of plastic lymph, hydrops articuli is distinguished by the fluc-

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[[1] Graham, N. Y. Med. Record, Aug. 11, 1877; Aug. 16 and 23, 1879; Weiss, Wiener Klinik, 1879, 11th and 12th Heft; see also Schmidt's Jahrbuch., Bd. 175, 1877, No. 7; Berghmann, Viertel-Jahrschrift f. d. prakt. Heilkunde, 1876; Verneuil, discussion on treatment of Joint Disease, Med. Times and Gaz., Oct. 18, 1879, p. 454; Gaz. des Hôpitaux, 1879, p. 1053.]

tuation, which, as M. Bonnet remarks, is best recognized by placing one hand above and the other below the tumor; if they are placed transversely, the displacement of the muscles or tendons may be mistaken for the movement of fluids. From abscess of the joint, it may usually be distinguished by the condition of the soft parts around, as well as by the constitutional symptoms, though it occasionally happens that the true nature of the effusion can only be determined by puncture with a needle. The prognosis in these cases is most favorable; at least, the other structures of the joint seldom become involved, though the disease itself may be difficult of cure and very prone to relapse, especially in cases of some standing.

Treatment.—If any inflammatory symptoms are present, these must first be subdued by the ordinary constitutional remedies; by leeches and fomentations, or by cooling lotions. When all traces of inflammation are subdued, and the affection has assumed the chronic form, the joint may be blistered, or painted frequently with a strong solution of iodine; this may be followed by compression by means of adhesive plasters and bandages, accompanied by stimulating and mercurial applications directly to the skin, for the purpose of promoting absorption. If the case is recent, under such treatment the effusion may be expected to subside; but it will still be necessary to support the relaxed membrane by wearing a laced or elastic knee-cap for an almost indefinite period.

In old and neglected cases, on the other hand, the affection resists all ordinary treatment, and must either be abandoned as incurable, or further and operative measures had recourse to, the most promising of which are iodine injections, employed as in cases of ordinary hydrocele. Should it be considered advisable to have recourse to this plan, and the knee be the joint affected (as is most commonly the case), the spot selected for the puncture is that part of the synovial membrane which is situated above and external to the patella; the limb should be in the extended position, and the opening rendered valvular by pulling aside the skin before introducing the trocar, which should be only of moderate size. The fluid injected may consist of tincture of iodine more or less diluted. In a case of hydrarthrosis of both knees in which a permanent cure was effected by this injection, after all other treatment had failed, Mr. Goodall[1] used equal parts of the tincture and of water, whilst Schuh,[2] who has employed this treatment successfully in three cases, made use of one part of tincture of iodine to four parts of water. The quantity injected may vary from half an ounce to two or three ounces, the latter quantity being that recommended by Schuh. As much as possible of the fluid is allowed to escape, after being retained in the joint for about five minutes, and care taken to prevent any admission of air to the articulation. When the trocar is withdrawn, the cutaneous wound is coated with collodion. The immediate result of the injection is to produce a certain amount of inflammation; to prevent this from going too far, the limb must be retained in a state of immobility after the operation by means of a properly adapted splint, and the case watched carefully, so that antiphlogistic measures may be had recourse to if necessary. [The results of the injection of the tincture of iodine in the treatment of hydrarthrosis are: 1. A complete cure with preservation of mobility; 2. Cure with a certain amount of stiffness; 3. Complete failure: 4. Suppuration and injury to the joint. The first and last classes of results are said to be uncommon. From a few dissections of joints after the injection of iodine it would appear that the irritant did not bring about adhesions, but caused a change in the character of the synovial wall.[1]] This treatment is only suitable to cases of simple dropsy, uncomplicated with diseased conditions of the bones and cartilages, and would only be advisable when all other measures had failed, and much inconvenience was occasioned by the distended capsule.

[The antiseptic system of dressing wounds having rendered direct incision into the joint a much safer operation than was formerly thought to be the case, that method is likely to entirely supersede tapping with a trocar, and the injection of iodine. Aspiration of the knee-joint, a much simpler method, appears to be a procedure devoid of danger. Dieulafoy has been most active in introducing this mode of treatment. He reported (Gaz. des Hôpitaux, May, 18, 1878) 200 aspirations of the knee-joint, and regards the operation as a rational and efficient one. A rubber bandage is to be placed around the joint, leaving a spot uncovered for puncture. The point of election in the knee-joint is the external cul-de-sac, on a level with the upper border of the patella. Compression is used as soon as the fluid is evacuated. The aspiration is to be repeated in twenty-four hours if the joint refills. In some cases it is necessary to aspirate six or more times before cure.[1]

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[1] British Medical Journal, No. 367.

[2] Wien. Zeitsch., N. F., vol. iii., p. 5.

[[1] Panas, Nouveau Diction. de Med. et Chir., "Articulations;" see also Allg. Wien. Med. Zeitung, April, 1878, p. 178; Hydrarthrosis, Recherches sur le rôle de certaines influences dans le developpement; Grenier, Thèse de Paris, 1878.]

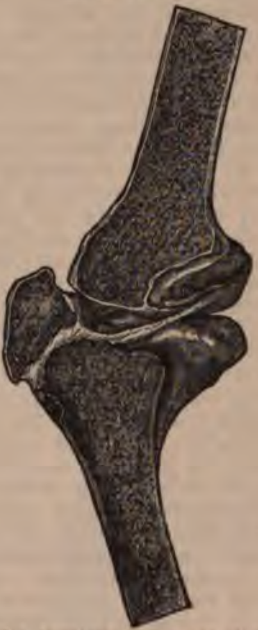
Seeligmüller[2] mentions a hitherto undescribed affection of the joint, an intermittent hydrops articulorum, usually affecting the knee, more rarely also the hip. In the majority of cases a swelling appears without febrile symptoms and from no known cause, and disappears, reappearing after a certain interval. The duration of the attack is usually four days, and the pause between the attacks from eight days to a fortnight. No treatment seems to be of avail.]

Scrofulous synovitis: pulpy degeneration.—There is a peculiar form of slow inflammation of the synovial membranes, which is sometimes described under the name of *gelatinous* or *pulpy degeneration of the synovial membrane*, but which appears to be inflammation of a chronic character, modified, possibly, by the scrofulous condition of the system. If we have an opportunity of examining the joint when the disease has advanced to a certain extent, the principal points which attract attention are the thickening of the synovial membrane, and the gelatinous or pulpy appearance which it presents. The vascularity of the membrane is increased, and the mass of its substance appears to be converted into a soft yellowish or light-brown gelatinous material, frequently of very considerable thickness. The articular cavity becomes diminished as the thickening extends upon the *internal* surface of the membrane; and as this extension goes on most freely in the loose synovial folds which surround the cartilages, these are often partially or completely buried and concealed beneath the new formation. A somewhat similar process occurs at the same time in the areolar tissue at the *outer* surface of the membrane, which becomes condensed and infiltrated with a corresponding pulpy substance.

The joint may remain in this condition for a considerable period, and then, under favorable circumstances, a process of restoration occurs, the new elements shrink or are absorbed, and the articulation is restored more or less perfectly to its former condition. More frequently, however, the disease makes further progress; the gelatinous thickening of the synovial membrane extends further over the cartilages, which become themselves secondarily affected in spots; though these spots are not, necessarily, at first, in *direct* relation with the altered membrane. The precise nature of the change which occurs in the cartilage will be considered in the description of the diseases which affect that structure; it need only be said here that the cartilage becomes more and more altered at the points first affected, and that intimate adhesion soon takes place between the granulation-tissue which these points present and the corresponding growth from the synovial membrane. The change in the cartilage is attended or followed by inflammation of the bone on which it rests; the articular lamella gives way in places, a communication between the osseous tissue and the interior of the joint is formed, and granulations spring up from the inflamed membrane lining the cancelli, which join with those already existing within the articulation. In the mean time matter has most probably been formed, which may be retained within the articular cavity, or may make its way to the surface by means of sinuses.

If the disease still makes progress, the gelatinous growth continues to extend in an outward direction, or it degenerates in patches, giving rise to fresh formations of matter in its own substance or in the ar-

Fig. 662.



Section of a knee-joint, the bones of which are united by ligamentous tissue after scrofulous disease. (From a preparation in the Museum of St. George's Hospital.)

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[1] H. O. Marcy, Aspiration of the Knee-Joint, Trans. Am. Med. Assoc., 1879. Piechaud, Ponction et Incision dans les Maladies Artic., Med. News and Abstract, Aug., 1880, p. 498; Riedel, Hæmarthros, Centralbl. f. Chir., 1880, 10.]

[2] Berliner Klinische Wochenschrift, 1880, p. 106.]

ticular cavity; the constitutional powers now probably fail, the tissues of the joint, including the osseous, are still further destroyed, and amputation or excision is had recourse to, or the patient dies hectic. When, on the other hand, an improvement takes place, the new growth is directed inwards towards the articular cavity, which it tends to fill up. As the constitutional powers improve, the gelatinous material becomes firmer and more fibrous, it continues to contract, the cavity within it diminishes and is obliterated, the bones are united by a firm and solid substance, and the joint is ankylosed, as in the accompanying figure.

Symptoms.—Pulpy degeneration makes its appearance most frequently in early life, at or before the time of puberty, though no period of life can be said to be absolutely exempt from risk of its occurrence. In many instances the immediate attack can be traced to some slight accident or other local source of irritation; in others no such cause can be discovered, the attack appearing to commence, as we may say, spontaneously. It is characterized by a want of acuteness, even at its commencement, the earliest symptom noticed (supposing the disease to be in the lower extremity) being slight limping, followed by some swelling about the joint.

The nature of the affection is most clearly recognized in those joints which are the most superficial. In its early stages it is characterized by stiffness of the joint, and the presence of a soft, elastic, colorless swelling, occupying the whole extent of the articulation. The absence of genuine fluctuation should prevent the disease from being mistaken for dropsy or abscess of the joint; the size and doughy feel of the swelling distinguish it from simple synovitis; whilst its whiteness is opposed to the darker tint which is usually met with in malignant disease. The early stages of the swelling are usually accompanied with comparatively little pain, the disease in many cases being very insidious in its progress; in this respect, as well as in the shape of the swelling, which extends equally over the whole joint, instead of being specially manifest in the situation of one of the bones, differing from disease commencing in the cancellous structures. If the progress of the case is towards recovery, the swelling ceases to increase, solidifies slowly, and gradually diminishes in size, the pain at the same time yielding, and the condition of the general health becoming much improved. Even if arrested in this early stage, a considerable amount of loss of free movement of the joint must be expected, and great care taken that no recurrence of the symptoms is produced by too early exercise.

When the disease advances, the enlargement and stiffness of the joint increase, the pain, which was previously perhaps little more than a sense of aching or feeling of fulness, becomes more marked and altered in its character, being now described as a "jumping," "gnawing," or "starting" pain, and felt with special acuteness at night-time. This change may be considered a sign that the disease is no longer confined to the synovial membrane; that the cartilages are becoming ulcerated, or rather, more strictly speaking, that the bone on which those cartilages rest is itself participating in the inflammatory action. Another symptom, which would indicate a considerable amount of destruction of cartilage, is the existence of crepitation on any movement of the joint by the patient himself or by the surgeon. This crepitation, however, it should be recollected, may disappear or be masked at any time in consequence of soft and extensive granulations rising from the bones, and preventing their articular surfaces from rubbing on each other. The limb is now in danger of becoming rigidly fixed by spasmodic contraction of the muscles, causing it to assume positions varying in the different articulations, but all tending to produce future embarrassment, unless carefully watched and guarded against.

Before the disease has advanced to this point, in the majority of cases suppuration has occurred, either infiltrating more or less extensively the gelatinous mass, or limited so as to form circumscribed abscesses in its substance, or accumulated in the remains of the synovial cavity. If collected within the joint, there will be a general increase of the swelling, with throbbing pain, and perhaps fluctuation, attended by febrile disturbance to a greater or less extent. After a time the matter makes its way through the softened walls, and "pointing" takes place at spots determined by anatomical peculiarities referable to the individual joint; the sinuses so formed presenting subsequently large and flabby granulations. When the abscess is situated in the gelatinous mass itself, the increased swelling, instead of being general, takes place at any part of the mass which may happen to be the seat of the degeneration, and the opening forms at or near this point. In most cases, however, even when the joint-cavity was originally free, it becomes involved subsequently in the parietal abscess.

In proportion to the deterioration of the constitution will be the extension of the destructive action. The ligaments and neighboring parts become softened and destroyed, the altered extremities of the bones are no longer firmly united to each other, and in this condition a partial or comple dislocation is occasionally produced under the influence of spasmodic muscular action; this dislocation being often attended with decided relief to the severity of the symptoms. If the constitutional powers improve, it is still possible for a process of repair and recovery to occur. The discharge in such cases diminishes, the openings contract and ultimately close, the skin resumes its natural appearance, while the swelling decreases and becomes more solid. The diminution in size of the joint continues till it becomes even smaller than it was before the attack, and the skin presents a peculiar puckered appearance around the articulation and at the seat of the cicatrices. The restorative process is of course attended with anchylosis, fixing the limb in the position it may have been allowed to assume.

This form of disease has generally been supposed to be strumous in its character, and connected with the scrofulous diathesis. Mr. Holmes,[1] however, has questioned its constitutional origin, and advanced many excellent reasons for doubting whether, in a large proportion of cases at any rate, chronic joint-disease may not simply be the result of some local injury or irritation, and essentially independent of any general cachexia, though strumous persons would be at least as liable to it as others. At any rate, as Mr. Holmes justly remarks, "whatever our views may be as to the pathological question, I think we must all agree that practically we have no such proof of the constitutional nature of any of these chronic joint-affections as should lead us to refuse to entertain the general question of operative treatment. Individual cases must be judged of by their own symptoms."

[The question of the "strumous" nature of chronic joint affections has lately attracted renewed attention. The two opposite opinions are well defined by the statement of Dr. Gross, that hip-joint disease could never occur unless a tuberculous diathesis were present, and that of Dr. Sayre to the effect that children in perfect health, with a personal and family history absolutely free from taint, may acquire disease of the spine or hip-disease from traumatism.

Schüller's experiments are interesting in this connection. He produced a state of artificial tuberculosis in a number of animals by the injection and forced inhalation of tuberculous material. On these animals, and on others in a state of health, he inflicted injuries, contusions, and sprains at the knee-joint. Recovery took place in the healthy animals, but in the tuberculous, the joints developed symptoms of fungous arthritis; this pathological condition was demonstrated on killing the animals and examining the joints. The joints of the healthy animals when killed were found in a normal condition, with the exception in some cases of evidence of extravasated blood and effusion in the process of absorption.

Dr. Gibney, after a careful examination of the clinical histories of 860 cases, found that in 56 per cent. no evidence of fall or injury could be ascertained. There was evidence in almost all of this class of patients of an inherited or acquired enfeebled physical condition. This was also the case in the remaining class where an injury appeared to be the original cause of the disease.

It is the experience of many that children in apparent health will be found suffering from the initial symptoms of joint affections—the same is true of patients with phthisis—and it is probably a fact that a "dyscrasia," as the term was used by the older pathologists, need not be considered as essential in the causation of either of these classes of diseases. But there is at present no evidence to warrant the belief that a fungous arthritis can be developed, without the existence of what may be termed "vulnerability." This may be an inherited physical defect, the legacy of a previous severe disease, or the result of faulty assimilation from imperfect nutrition.

A number of recent observers have established that in fungous arthritis, miliary tubercles are to be found in the granular articulations springing from the articular ends of the bones from the synovial membrane. It has been claimed that this is the characteristic lesion which distinguishes this form of joint disease from the less destructive simple synovitis, but the arguments to support this view are not as yet sufficiently strong to establish it beyond a doubt. The tubercle found in these granulations may be simply a secondary change common in the slow and chronic grade of inflammation occurring in "strumous" arthritis, and not the essential cause. As is well known, Bonnet claimed the existence of a form of tumor albus, distinct in its course, which he regarded as tuberculous. Tubercles were to be found in the epiphysis, or more frequently in the synovial membrane. König, however, regards it as established that arthritis fungosa is always the result of tubercles, which are more frequently found originally in the bone than in the synovial membrane. Lannelongue, however, describes an articular tuberculous synovitis, which he believes is much more common than is generally supposed.

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[1] Surgical Treatment of Children's Diseases, pp. 424-7.

H. Hueter found that the injection of tuberculous matter directly into a joint produced a chronic fungous arthritis with miliary tubercles in the lungs, but none in the joint; injection of tuberculous matter into the peritoneal cavity caused tuberculosis of the lungs, but no change in the joints. To Köster belongs the credit of having first demonstrated the presence of miliary tubercles in fungous disease of the joints, or rather bodies resembling histologically in every particular what are universally characterized as miliary tubercles;[1] but as such cases have not come to autopsy until the osteitis was well advanced, it is impossible to say which is primary and which secondary.[2]

To generalize from this, as has been done, that the process in the joints is a local one, and not constitutional, is not warranted by the facts, as it is also not justifiable to conclude, that if a pronounced osteitis is recognized excision is demanded to prevent general tuberculosis.]

Treatment.—In our treatment we have to bear in mind that we are dealing with an affection originating in inflammation, but that inflammation of a chronic character and not improbably modified and altered by the strumous diathesis. Our efforts consequently have steadily to be directed to the improvement of the constitutional condition. Good air and plenty of it, warmth and light, attention to cleanliness and proper diet, are in all cases clearly inculcated. Where the tendency is to *scrofulosis*, the liver and bowels are usually sluggish, and require to be stimulated occasionally by tolerably brisk purges, combined with quinine; whilst in *tuberculosis*, purgatives must be given with caution, and be of the mildest character. In both cases tonics, and especially cod-liver oil, are of service; though these tonics should be administered with judgment, and in relation to the presence or absence of inflammatory fever.

The essential part of the local treatment consists in the joint being kept in a state of perfect and continuous *rest*, by means of splints, which should be well and properly made, and constructed so as completely to prevent any motion of the limb, and at the same time admit of any topical applications which may be deemed advisable. As the chance of ankylosis occurring is more considerable than in cases of ordinary synovitis, the *position* of the limb becomes of even greater importance, though it is to be regulated on the same principles. The splints may be made of leather or of pasteboard, or constructed of wire in the mode recommended by Bonnet and by Syme. If made of iron wire, a strong piece is bent to the shape of the limb, extending on both sides and united transversely to such an extent as to give the requisite degree of strength. The splint so formed is carefully lined with soft leather, or fitted with a kind of cushion, and will often prove highly useful. Too much attention can hardly be paid to the selection and adaptation of the splint in the first instance, and to the necessity of its being worn uninterruptedly for a very long period of time. If inflammatory symptoms are present, it may be necessary to employ a few leeches, or to use cooling or warm applications, as may seem expedient. As the inflammatory symptoms subside, counter-irritants may be had recourse to; these, however, should be employed with some degree of hesitation, and with the cautions previously pointed out as specially applicable to their action on the superficial joints. At the Hospital for Sick Children I became latterly more sparing in my use of them. Mr. Barwell,[1] however, strongly recommends the employment of the actual cautery in these cases, when the first symptoms of inflammation have somewhat subsided, but when some such action still continues, and enlargement is still going on. The iron is to be white hot, and applied in lines, about an eighth of an inch in breadth and three inches in length, parallel to the axis of the limb. Four such lines are recommended for the knee, two on each side of the patella, at least an inch apart; dry lint may be applied immediately after the cauterization. The advantage of this plan, according to Mr. Barwell, consists not merely in its acting as a counter-irritant, but also in the pressure produced subsequently on the subjacent parts by the contracting cicatrices. Extension by means of weights, as described in a subsequent part of this essay (see p. 267), is also of considerable service in many cases where the joint affected is in the lower extremity.[2]

Where the disease is confined to the synovial membrane, and has assumed an entirely passive condition, measures may be properly adopted to produce absorp-

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[[1] Virchow, Arch., 48, s. 95.]

[[2] Birch-Hirschfeld, Pathologie.]

[1] On Diseases of the Joints, chap. v.

[[2] Volkmann's Klinische Vorträge, 102; Kocher, Centralblatt f. Chirurgie, Jan. 26, 1878; Jaffé, Gazette des Hôpitaux, Sept. 9, 1880. Gibney, N. Y. Med. Journal, July, 1877; Lannelongue, Centralbl. f. Chir., No. 20, 1879; Schüller, Schmidt's Jahrb., p. 53, 1879; Bull. de la Société de Chir. de Paris, t. iv., No. 4, 1878, p. 295; Brissaud, Am. Journ. Med. Sc., April, 1880; Lee, Chicago M. T. and Examiner, 1880, xl., xli.; König, Deutsch. Z. f. Chir., 1878–9, xi., 531, 570.]

tion of the indolent gelatinous mass. Such measures would obviously consist in *friction*, *passive motion*, and accurately applied *pressure to the part*. These means, as pointed out by M. Bonnet, may be freely adopted, but still with care and caution, and at once abandoned if symptoms of renewed activity in the disease show themselves. If any camphorated mercurial application is used to the part, along with the pressure, in the way described as "Scott's dressing," it should be employed in these cases very sparingly, and in a very diluted form; the joint, too, should be examined frequently, to make sure that no fresh attack of inflammation has occurred. As the case progresses towards recovery, friction and passive motion are more freely used, and the treatment assimilates to that of ordinary chronic synovitis. Should suppuration take place within the joint, the matter must be evacuated by free incisions made in depending positions, followed subsequently by slightly stimulating lotions to the sinuses, and moderate pressure to the joint, which is still to be maintained in a state of perfect rest, as well as in a suitable position. If the health give way, or the strength appear unequal to bear a long-continued discharge, and the circumstances of the case be such as not to admit of a prolonged use of the treatment which may be desirable, amputation of the limb or excision of the joint will often become necessary. Should improvement, on the other hand, take place, and cure by ankylosis be effected, we must be careful to employ passive motion in due time to prevent ossification, and maintain the uniting material in its fibrous condition.

Rheumatic synovitis.—In the description of synovitis, it was stated that this frequently arose from exposure to cold, or in connection with other causes loosely spoken of as rheumatic. The synovial membranes and parts about the joints are also liable to suffer in a special condition of the system by which the inflammatory process is materially modified, and which constitutes "rheumatism" properly so called. In acute rheumatism or rheumatic fever, the articular affection, although it may be severe and troublesome enough, is evidently dependent on constitutional derangement, culminating in a kind of inflammatory paroxysm assumed to be connected with excess of lactic acid. Unlike ordinary synovitis, the constitutional disturbance in this case is primary instead of secondary; and though a joint, when attacked, may display signs of severe and acute inflammation, yet these signs will often disappear with extraordinary rapidity, whilst other articulations become as suddenly affected. Acute rheumatism, therefore, being essentially a constitutional malady, falls naturally to the care of the physician, and its description must be sought for in works on medicine.

Chronic osteo-arthritis; chronic rheumatic arthritis; rheumatic gout.—The synovial membranes, as well as the other structures entering into the composition of a joint, are liable to a chronic affection, which has long been practically recognized, though varying names have been assigned to it at different times, or according to the class of joints which it happens to implicate. The term *nodosity of the joints* was the one proposed by Dr. Haygarth, whose attention was attracted to the hard swellings presented by the smaller articulations of the hands and feet, which at the present day more commonly receive the appellation of *rheumatic gout*. When the larger joints, such as the shoulder, the elbow, or the knee, are implicated, the disease is often termed *chronic rheumatism;* whilst a similar affection of the hip has been described by some authors as the *morbus coxæ senilis*. Dr. Adams, of Dublin, however, in his valuable work on the subject, has arranged and classified the varieties of the affection, and proposed the term *chronic rheumatic arthritis*, for which, however, the name *chronic osteo-arthritis* has lately been substituted in the official Nomenclature of Diseases. It will be seen that the disease implicates other tissues besides the synovial membrane; and, indeed, the changes which occur in the bones in these cases are so specially marked, that Mr. Barwell considers the morbid action to be in reality a rheumatic osteitis. The first obvious symptoms during life, however, are those in relation with the synovial membrane, and the earliest traces of disease after death have been found to be connected with the same tissue. Cruveilhier, Dr. Robert Adams, and Sir Benjamin Brodie coincide in the opinion that a chronic inflammation of the synovial membrane is the earliest local result as far as the articulation is concerned; and I have therefore thought it best to notice the affection in the present section.

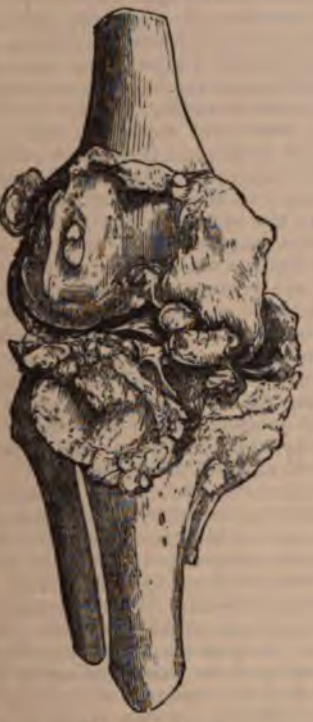
Chronic rheumatism is met with in two distinct conditions; as a palpably constitutional affection, implicating a multiplicity of joints, and either succeeding to rheumatic fever or following exposure to the usual exciting causes of rheumatism; and, secondly, as a local affection attributed to over-exertion, or injury, or arising without any assignable cause. The two sexes are, perhaps, nearly equally liable to be attacked; but Dr. Adams is of opinion that the larger joints, especially the hip, are more frequently affected in males, whilst females are more subject to the disease in the smaller articulations, such as those of the fingers; a fact which was originally pointed out by Dr. Haygarth. Though usually met with after middle age, chronic rheumatism is by no means confined to elderly people, for it has been seen in patients under the age of twenty, affecting simultaneously a considerable number of joints. Nor is it confined to any special rank; for though it prevails extensively among the laboring poor, it is also frequently met with in the wealthier classes, among those who have led indolent and luxurious lives, and in whom it is apt to assume a more decidedly gouty character. Though chronic rheumatism materially diminishes the *comfort*, it does not appear to shorten the actual *duration* of life, at least in those whose means allow them to be supplied with all requisite appliances; the very poor, however, are exposed to accidental or extraneous maladies, from the helpless condition to which they are reduced, and so with them the chances of life are diminished. When once the disease has become established, its tendency is to progress, slowly but surely, until the joints affected become ultimately disorganized to a greater or less extent; sometimes the affection remains quiescent, or stationary, for an indefinite period; but very seldom indeed can anything like a cure be anticipated, and then only when the case has been recognized and the treatment commenced before the disease had made much progress.

As far as the local affection is concerned, if we have an opportunity of examining the joint at a very early stage of the disease, we find redness of the synovial membrane, which becomes thickened and fibrous, whilst its fringe-like processes are much developed, and more vascular than usual, the internal surface of the capsule presenting somewhat of the appearance of a villous mucous membrane. There is also effusion of a moderate amount of fluid within the joint. At a later period, the fluid is absorbed; but the ligaments, which had been distended by the effusion, recover themselves but slowly, laying the foundation, perhaps, of the partial or even complete dislocations which are occasionally produced subsequently by the spasmodic muscular contractions which are apt to occur in certain stages of the disease. The capsules become very considerably thickened, and sometimes a bony deposit may be met with in their substance; in the interior of the joint, too, there may be found one or more of those foreign or extraneous bodies which are noticed separately in this essay under the head of loose cartilages. The articular cartilages by this time are probably affected; at certain points they assume a yellowish hue, and become fibrous. As the disease progresses, they are destroyed to a greater or less extent; sometimes presenting patches of dense bone, which are smooth and glistening; whilst at other times the cartilaginous tissue disappears entirely. and in its place we find a compact ivory-like bony material, which soon becomes highly polished under the influence of the attrition to which it is subjected, or is marked with linear furrows, resulting from the increased wear to which it is exposed in certain situations in the movements of extension and flexion. In the hip-joint, the round ligament, and in the shoulder the tendon of the long head of the biceps, or the glenoid ligament, will often be removed by the process of absorption. The proper osseous structure becomes condensed beneath the articular surfaces, and bony vegetations are thrown out around them, forming buttresses which interfere with the movements of the joints by their mutual apposition. The shape of the articular surfaces is altered; the globular heads of the femur and humerus are flattened, and. as it were, crushed, and the cavities for their reception exhibit a corresponding change resulting in varying amounts of deformity. These alterations have sometimes been mistaken for fracture of the neck of the humerus, or of the cervix femoris, in which bony union had taken place. It may be mentioned, too, that the abnormal condition is not always confined to the articular extremities, but may involve the shaft, or even the entire bone.

The general symptoms in these cases present no very special character. In some instances, as Sir Benjamin Brodie remarks, the disease appears to be connected with over-indulgence in animal food, and the patient experiences some of the usual effects of dyspepsia, such as a tendency to acidity and flatulence. In other cases, and especially, perhaps, where the larger joints are implicated singly, no particular constitutional derangement can be detected, and, indeed, it is remarkable to how slight an extent the general health is affected by the great amount of topical mischief which may have occurred.

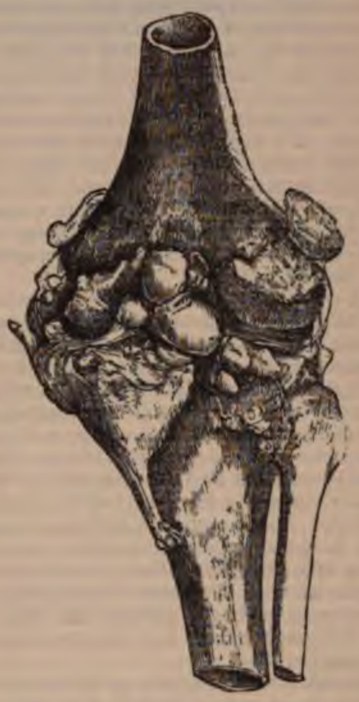
The local symptoms are the most characteristic, and consist essentially of *pain, enlargement and ultimate deformity of the joint, rigidity or stiffness*, and a peculiar *crackling noise*. The pain experienced is principally felt at night-time, or when the joint is set in motion after a period of rest. The amount of pain, which is usually of an aching character, is far less than might be expected from the amount of structural alteration which occurs, and very different from that experienced in other affections of the articular ends of the bone implicating the joints. When only a single articulation is involved, the general suffering is not great, and the patient's condition is very tolerable; even when several joints are attacked, the amount of pain experienced may be only trifling, though it may become aggravated, especially under the influence of cold and humidity, and of atmospheric changes, to such an extent as to render rest almost impossible. In the earliest stages, when the enlargement depends probably on increased effusion into the synovial membrane or the bursæ in its neighborhood, the swelling is soft, and fluctuation may sometimes be detected. At a later period the swelling becomes hard, and osseous growths may often be felt connected with the periosteum and extremities of the bones, which lead to alterations in the form of the articular surfaces, and give rise to great and peculiar deformity, varying in the individual joints, but characterized in the smaller ones, such as those of the fingers, by the appearance of irregular knots; whence the term *nodosity of the joints*, proposed by Dr. Haygarth. The accompanying illustrations from a preparation in the Museum of the Middlesex Hospital, show the changes in the shape of the bones, the eburnation of the articular surfaces, the copious deposit on the bones in the neighborhood of the joint-ends, and the numerous additamentary bones which are met with in old cases of osteo-arthritis. The case is related by Mr. De Morgan in vol. xix. of the Pathological Transactions, where also a drawing will be found showing the extraordinary change of shape which had occurred in the upper end of the femur.

Fig. 663.



Anterior view.

Fig. 664.



Posterior view.

Chronic osteo-arthritis of the knee-joint. (From a preparation in the Museum of the Middlesex Hospital.)

It may be noticed that there is little or no tendency to suppuration in these cases; abscess of the joint rarely, if ever, taking place. The amount of articular rigidity which occurs is peculiarly striking, rendering the affected joints practically useless, and simulating ankylosis, though true ankylosis rarely, if ever, occurs. In the advanced stages of the disease, stiffness or even immobility of the articulations may be present, depending on the deformity which has occurred in the articular surfaces, and on the bony outgrowths which have formed; and where many joints have been affected, the unhappy patient may be confined to his bed in a state of utter helplessness. Though the muscles are not immediately implicated in the rheumatic affection, at some period of the disease, probably when the bone itself begins to suffer, painful spasms are apt to occur, contributing materially to the discomfort of the patient, and giving rise in some cases to the partial or complete luxations which are occasionally met with. When the joints have become rigid and practically useless, the muscles in the neighborhood degenerate and waste. The sensation of decided crackling experienced in the movements of the joint is evident both to the patient and to the surgeon, and is usually most marked when the articulation is first used after repose; it is especially noticed, therefore, in the morning. It depends upon the mutual attrition of the altered articular surfaces, and may be detected in most of the joints, but especially in the hip, and only disappears when complete rigidity has supervened.

[A distinction is made by some writers between chronic rheumatic arthritis and arthritis deformans.[1] The two varieties frequently shade into each other, but a clinical distinction is usually quite marked between that form which is accompanied by stiffness without deformity, and that where the alteration of the shape of the joint is manifest and characteristic. The former is usually the result of a subacute articular inflammation similar to that seen in gonorrhœal rheumatism, the sequela of acute rheumatism or originating spontaneously. The latter is the common affection seen in old people, and causing the deformed hands and crippled fingers frequent in them.

Remak and Benedikt regard this condition as the result of irritation of the spinal cord and sympathetic, akin to that observed in locomotor ataxia. A case of arthritis deformans has been reported where changes either primary or secondary were found in the cord and the trunks of the spinal nerves at the intervertebral foramina. The disease when attacking the smaller joints is usually symmetrical, according to Budd, Romberg, and Charcot, which would point to a central origin; it cannot, however, be considered that the existence of an "arthritis myelitica" is demonstrated, as claimed by Remak.

The articular ends of the bone are distorted by the absorption of the bone at places, and the formation of bony projections at others. The former change is due to an inflammatory subchondral wasting, and the latter to a cell-development from the cartilage, with subsequent ossification. The tendons in the neighborhood of the joint are sometimes ossified, and the adjacent muscles suffer atrophy.[1]]

Treatment.—Dr. Haygarth, to whom we are indebted for our earliest notices of this disease, lamented the scanty means of treatment which he could suggest, and hoped, when time had been afforded for investigation by the profession, that fresh and more successful curative measures might be discovered. These hopes, however, have as yet been only partially realized; and in the advanced stages of the malady, when the joint has been essentially disorganized, we can scarcely anticipate much improvement. Our treatment, therefore, to be of real service, must be adopted at the commencement of the affection; at a later period we can but hope to mitigate the symptoms, to relieve the sufferings, and, at best, to retard the progress of the disease. In the early stage, when inflammatory symptoms are present, and any movement of the joint is attended with acute pain, it may be necessary to employ cupping or leeches, to keep the part at rest, and support it by means of bandages or splints. Care, however, must be taken not to prolong too far the period of immobility, for in these cases especially, want of exercise of the joint has ere long a deleterious influence on its structure. When the acuter symptoms subside, therefore, and rigidity increases, the patient should be encouraged to use the limb, to promote polishing and induration of the articular surfaces. Warmth and friction to the part are usually grateful. Flannel should be worn; and shampooing may be employed, or local douches or hot-air baths had recourse to. At certain stages of the affection counter-irritation may be used in the form of blisters or of painting with iodine; and in the nodosities of the fingers, the local application of a solution of iodide of potassium under oiled silk is sometimes of service; or cod-liver oil may be applied externally, as recommended by Sir Benjamin Brodie.

[In certain cases of chronic rheumatic arthritis, the persistent employment of frictions, rubbing with oil, and vapor-baths, continuously carried out, appears to be of benefit.[2] Remak, Althaus, and others advise the use of the ascending continuous current, which in their hands has produced relief or improvement.[3] Volk-

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[[1] Ziemssen, Cyclopædia of Med. Senator, Rheumatism.]

[[1] Affections of the Joints Secondary to Changes in the Cord, in this volume.]

[[2] London Medical Record, Oct. 15, 1880.]

[[3] Senator, Ziemssen. Cyc. of Medicine.]

mann[1] reports success in treating some cases by forcible straightening under chloroform, followed by the immediate application of fixed apparatus (plaster-of-Paris bandages), preceded, when necessary, by tenotomy, and followed by massage and warm baths.]

The general or constitutional treatment must be adapted to the individual case, and to the stage at which the disorder has arrived. Where any gouty element exists, where dyspeptic symptoms are present, and the case appears connected with too full a habit, great attention to the diet becomes of importance; stimulants should be abstained from; sugar, fruits, and raw vegetables avoided; and a moderate quantity of potash or magnesia be administered three or four hours after each principal meal. In other cases, however, the system appears impoverished rather than too full, and here it may be necessary to employ a better and more nutritious diet. In the earlier stages of subacute inflammation, it may be advisable to give a few alterative doses of blue-pill, combined, perhaps, with acetous extract of colchicum, and to administer Gregory's powder at night-time, with an active aperient at regular intervals. Perspiration should be encouraged, too, by the use of the Turkish or hot-air bath, or by taking Dover's powder, or other medicines to act upon the skin. When the urine is clear, Mr. William Adams recommends the use of sulphur externally and internally, and also the free use of dilute phosphoric acid. At a later period, the iodide of potassium may be administered and continued for several weeks at a time, if it appears to suit the patient; for its action in these cases is somewhat uncertain. Various stimulating internal medicines may now be tried, such as turpentine or guaiacum; or cod-liver oil may be administered internally as well as externally; opiates also are usually of service for the purpose of procuring rest. Warm clothing should be used; and, where circumstances admit, residence in a warm climate during the winter months materially increases the comfort of the patient. Warm bathing is usually attended with relief; and if practicable, recourse should be had to the mineral springs, such as those of Bath or Buxton in this country, the hot sulphur baths of Luchon in the Pyrenees, Aix-la-Chapelle, Vichy, Ems, Wiesbaden, or Carlsbad on the Continent, [the Hot Springs of Arkansas.]

Gouty synovitis.—The gouty diathesis presents some points of resemblance to the rheumatic; in fact the chronic form of alteration of the joints just described is often termed rheumatic gout. The speciality of the gouty inflammation, however, consists in the sudden or "explosive" appearance of uric acid in the part affected, giving rise to more or less local disturbance. Gouty inflammation of the joints occurs in an acute or in a more chronic form. The acute form of gout requires no description here, as it is essentially a medical complaint, and is amply treated of in medical works. Where gout has assumed a chronic form, however, the local affection may predominate over the constitutional, and such cases may at times fall under the care of the surgeon; they require, therefore, to be briefly noticed.

When gout first attacks a patient, the joint usually recovers its original mobility as the "fit" passes off; but when repeated attacks have occurred, the restoration becomes more and more imperfect, and at last the articulation loses entirely its capacity for motion. Opportunities of examining the joint at an early stage are not common; but Dr. Garrod is of opinion that gouty inflammation is *invariably* accompanied by deposition of its peculiar salt. Unquestionably, as the disease advances, a deposit of the white, chalky-looking urate of soda takes place, in the substance of the ligaments and in the surrounding areolar tissue, as well as in the neighboring muscles; or it may occur in the interior of the joint, thickening the synovial fluid, and studding the synovial membrane with small white masses: or in the substance of the articular cartilages, in the form of white spots, resulting from the presence of the crystalline salt in the hyaline structure; or, finally, the urate may be deposited in the bone and in the periosteum. Resulting from this deposit we may expect to find, sooner or later, the tissues themselves undergoing changes; the synovial membrane will be thickened and vascular; the ligaments and areolar tissue condensed; and the cartilages subsequently become softened and are removed, so that the articular surfaces of the bones are exposed and altered.

Whenever a joint is subjected to protracted attacks of chronic gout, it is certain to be permanently injured, either by becoming so rigid that its functions are practically destroyed, or from the formation of *chalk-stones* around it. Chalk-stones—or *tophi*, as they are sometimes termed, from a Hebrew word signifying *concretion*—vary much in their consistence; they may be soft and semi-fluid, or hard as the chalk from which they derive their name. Under the microscope they present bunches of needle-like crystals of urate of soda; and chemically they are

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[[1] Billroth and Pitha, Handbuch der Allg. Chir.]

composed of that salt, united with a certain amount of animal or earthy matter. A concretion taken from the metacarpus was found by Lehmann to contain :—

Urate of soda	52.12
Urate of lime	1.25
Chloride of sodium	9.84
Phosphate of lime	4.32
Cellular tissue	28.49
Water, loss, etc.	3.98
	100.00

Chalk-stones are generally found in the smaller articulations of the hands and feet. They form protuberances, distorting and crippling the articulation, which approach the surface, till the skin over them is thinned, and allows their white color to become visible. Sir T. Watson relates the case of a gentleman who was in the habit, when at cards, of scoring the game on the table with his chalky knuckles. It may be mentioned, as sometimes facilitating our diagnosis, that there is another situation in which deposits of urate of soda are even more commonly visible than in connection with the joints, namely, in the cartilage of the external ear, in the form of little pearl-like bodies, varying in size from a split-pea to a mere white point, and situated usually about the fold of the helix. Out of seventeen cases in which Dr. Garrod detected gouty concretions, in seven they existed in the ears *alone*, in nine in the ears *as well as* around the joints, and only in one case were they found in other parts, but *not in the ear*. The gouty deposit, which is at first liquid, becomes harder in time from absorption of its fluid parts, and accumulates in many cases to such an extent as to render the joint completely fixed, whilst the neighboring structures are also inconvenienced by the distension to which they are subjected. The mere presence of the salt in connection with the joint does not appear usually to produce much irritation; after a time, however, inflammatory action, perhaps from a fresh gouty attack, may be set up, the integuments ulcerate, and a discharge, containing the urate of soda mixed with blood-globules, takes place through openings which are often most troublesome to heal. These abscesses, however, it may be mentioned, appear sometimes to act as safety-valves, and their cure is followed by renewed attacks of gout, which had been suspended during the time they remained open. The diagnosis between chronic gouty affections of the joints and the chronic osteo-arthritis already spoken of, is rendered easy when ulceration of the soft parts has occurred, and chalky matter exudes, which can be determined by chemistry to consist of urate of soda. At an earlier period some uncertainty may exist; though the case may be considered gouty, when it comes on after repeated and manifest attacks of gout, and when the gouty diathesis is plainly marked; it may be proved to be so, if a puncture of the swelling with a needle allows of the escape of fluid in which the presence of crystals of the urate of soda is revealed by the microscope: for the existence of this salt forms the specific characteristic of the *gouty* affection, and is never met with in rheumatism or in chronic osteo-arthritis.

Treatment.—As the disease is essentially a constitutional one, the treatment must also be mainly constitutional, and consists in impeding the undue formation of uric acid, as well as in getting rid of the surplus amount of the acid already existing in the blood. For the first purpose the diet has to be carefully attended to; the dyspeptic symptoms relieved as far as possible; the secretions, especially that of the liver, regulated; and the strength of the patient supported in those cases where there is a tendency to loss of tone. To free the blood, we may administer occasionally small doses of colchicum, when the strength of the patient admits of it; but our main efforts are directed to increase the action of the kidneys and skin by means of salines and alkalies. The salines, to be of service in chronic cases of gout, must be given in small doses and very diluted; they should be taken on an empty stomach and some little time before food. [Of the salines, the carbonates of potash and soda are the ones chiefly employed, and lime-water and magnesia; but the drug most recommended of late years is the carbonate of lithia.[1]] The mineral waters, properly selected, offer many advantages for the administration of saline medicines, as well from the state of dilution in which they are found, as from the greater chance of the patient continuing to take them for a sufficient time, while the mind is occupied and the attention diverted by the change of scene and hopeful statements afforded at the various spas. The external use of the waters can also be conveniently and usefully adopted. The spa to be selected must depend to a great extent upon the special characters of the individual case. In some, Carlsbad, Wiesbaden, or Vichy may be recommended; whilst in other cases, Aix-la-Chapelle, Teplitz, Wildbad, and Buxton are more likely to be of service. Where the debility is great, or after a course of other waters has been taken, the ferruginous springs of Schwalbach or of Pyrmont are often beneficial. For those who are prevented from going

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[[1] Senator, article "Gout," in Ziemssen's Cyclopædia of the Pract. of Medicine.]

to a great distance, or who are desirous of feeling their way and seeing which spring is likely to suit them best, a trial of the carefully prepared factitious mineral waters of the spa at Brighton may at times be deemed advisable, and the Turkish bath is often of much service.

It is, however, for the local mischief that the surgeon may principally expect to be consulted. The local treatment will vary according as it is directed simply to relieve the stiffness and rigidity of the joints, or to alleviate any active inflammatory action which may have been set up, with or without the formation of abscess and production of ulceration. To relieve the stiffness, one topical application has, indeed, been already alluded to, in the form of baths of the mineral waters. Where these cannot be had recourse to, weak alkaline lotions, with iodide of potassium, may be applied to the joint under oiled silk, or, supposing the smaller joints of the fingers to be affected, the whole hand may be wrapped in bandages saturated with water and then enclosed in a waterproof bag during the night. When a certain amount of low or chronic inflammatory action is going on in the ligaments and synovial membranes, small flying blisters are often useful, applied only for a short time, and with tissue-paper between them and the skin; in this particular condition, too, the internal administration of small doses of iodide of potassium is often of use. When acute inflammation occurs, as it may do when a new and severe attack of gout takes place in the seat of a chalkstone, the amount of swelling which ensues may cause the cutis to give way, whilst the cuticle remains entire. It is better in these cases to avoid, if possible, making any incision; for the salt is deposited not simply in the cellular tissue or collected as a mass, but also in the actual substance of the articular cartilages, and cannot, therefore, be expected to be entirely or freely evacuated. Soothing applications are of most service; but it may be remarked, that where an opening occurs naturally, or is made by the surgeon, the serious consequences frequently attendant on wounds of articulations are not to be expected, partly from the disorganization which has occurred, partly also, no doubt, from the unimportant character of the joint which is usually involved. Severe operative measures are not called for in these cases. While the inflammation runs high, poultices and fomentations are of most service; afterwards, gentle pressure may be employed, and the sinuses which are left should not be irritated by probing or by stimulant applications, but allowed gradually to contract and ultimately heal. As already stated, when ulceration has once occurred, the case is almost invariably tedious, and may be rendered more so by too active surgical treatment.

Pyæmic synovitis.—Acute synovitis, frequently leading to suppuration in the joints, is not a very uncommon consequence of purulent or systemic infection, and is met with in phlebitis, after operations, and in connection with certain puerperal conditions, as well as in the progress of fevers, etc. For the description of the general condition giving rise to this complication, its symptoms, and its treatment, the reader is referred to the essay on PYÆMIA. It need only be stated here, that when this pyæmic condition exists, there is always danger of the joints, as well as of other parts of the body, becoming the seat of the local disturbance. Sometimes the attack is marked by the occurrence of violent pain, accompanied or followed by heat, redness, and swelling, affecting one or more of the articulations, which may present distinct fluctuation, provided they are superficially situated. In these cases more or less thin and liquid pus may be found in the interior of the joint, or in some instances, diffused throughout the external areolar tissue. In other cases, however, large deposits of pus may take place in the joint, suddenly or insidiously, unaccompanied by pain, and perhaps unsuspected during life. The number of joints affected may vary considerably. Only one may be attacked, or it may be difficult to find a single articulation which does not present pus when cut into. The inflammatory condition may remain confined to the synovial membrane, but frequently extends to the other structures, which become more or less disorganized. In a case of suppuration of the knee, following thecal abscess of the finger, Dr. Handfield Jones found increased vascularity of the synovial membrane, with villous projections from its surface; whilst the articular cartilage was ulcerated in places, the cartilage-corpuscles containing a greatly increased number of celloid masses in their interior, and the intercellular substance being fibrous, and deprived of its natural consistence.

The *treatment* in these cases is mainly directed to the relief of the constitutional infection, and its principles have been laid down in the essay on PYÆMIA. Locally, when we have reason to suppose that a joint is becoming implicated, it should be maintained in a state of perfect rest upon a splint, and the pain relieved by soothing applications. When suppuration has indubitably occurred within the joint, a free incision for the purpose of evacuating the matter is desirable, and the local treatment already recommended for abscess in the synovial membrane becomes applicable.

[Poly-articular inflammation of the joints, similar to that termed gonorrhœal rheumatism, has been occasionally observed after catheterization, or the introduction of lithotrites, by Velpeau, Civiale, and Bonnet.[1]]

Gonorrhœal synovitis; gonorrhœal rheumatism.—A form of synovial inflammation is occasionally met with in connection with purulent inflammation of the urethra, or even with purulent ophthalmia. This complication appears to have been first described by Sir Benjamin Brodie, and usually passes now under the name of *gonorrhœal rheumatism*, though it differs in several respects from rheumatism, and is not necessarily connected with gonorrhœa. In these cases, during the existence of a urethral discharge, which may depend on gonorrhœa, or arise after the passage of a bougie, inflammation occurs in the synovial membranes of one or more of the joints, more particularly in the knee. Another peculiarity, which was pointed out by Sir Benjamin Brodie, is, that some form of ophthalmia very commonly accompanies or precedes the articular affection, or may alternate with it. All stages of gonorrhœa may present this complication, and usually no material change in the discharge is noticed, though sometimes it declines a little, when the synovial affection shows itself. The articular inflammation may last for a few weeks, or may continue for months or even years. It is very apt to involve one joint after another, and presents a decided disposition to relapse. There is little tendency to suppuration, but sometimes the synovial membrane is thickened, and the movements of the joint permanently interfered with. In some few instances the case is much more severe; the cartilages become involved, and permanent rigidity may be the result.

The immediate cause of this affection is still a matter of dispute. By some it has been considered to be connected with the gouty habit;[2] whilst Mr. Barwell considers it to be "in reality a slower form than ordinary of purulent infection, produced by inflammation of the prostatic veins."[3] He allows, however, that he has "no cases of dissection to prove this position," but the following case, related by Mr. Prichard, certainly seems to favor Mr. Barwell's views.

> A patient in the Bristol Infirmary for gonorrhœa and orchitis, was attacked with feverish symptoms, followed by great pain and swelling in the right knee. In a few days the lower part of the thigh was filled with matter which had escaped from the distended synovial membrane. The limb was subsequently amputated, and the joint found to be completely disorganized.

Treatment.—The local treatment in these cases is much the same as that recommended in ordinary synovitis. So long as acute inflammatory symptoms are present, the usual antiphlogistic measures must be had recourse to, and if the pain is very severe, as is sometimes the case, subcutaneous injections of morphia may be employed; when effusion remains, free blistering should be employed, and "Scott's bandage" applied in those cases where there is thickening about the joint. At a subsequent period, friction, shampooing, local vapor baths, or the use of the mineral waters of Buxton or of Wiesbaden, will probably be of service. The general treatment must also be conducted on the ordinary physiological principles. As the inflammatory excitement passes off, the iodide of potassium, combined with colchicum and opium, may be administered, along with occasional active purgatives; to be followed at a still later period by mild tonics. In the more chronic forms of the disease the greatest benefit will be derived from change of climate, including a residence at the mineral springs recommended for chronic rheumatism, with the use of the waters both internally and externally. The treatment of this affection by keeping bougies in the urethra, or by the administration of cubebs and copaiba, as once recommended, is hardly likely to be often had recourse to in the present day.

Syphilitic synovitis.—The character of the synovial inflammation in some cases is modified by the existence of constitutional syphilis. Occasionally, as Sir Benjamin Brodie remarks, the synovial membranes of one or more joints assume a sluggish form of inflammation in the early stages of secondary syphilis, in connection with papular eruptions. More frequently, perhaps, the joint-affection comes on at a more advanced stage of syphilitic infection, in connection with affections of the bones, and especially of the periosteum. The inflammation in most cases is anything but rapid in its progress or acute in its symptoms, though the nocturnal pains may be severe; and it is readily distinguished by its occurrence during the ex-

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[[1] Volkmann; Billroth and Pitha, Handbuch der Chirurgie.]

[2] Johnstone, On the Genito-Urinary Organs, p. 317.

[3] On Diseases of the Joints, p. 101.

istence of other and characteristic symptoms of venereal blood-poisoning. Its constitutional origin is also marked by its tendency to affect more than one joint. The general treatment is naturally directed to the cure of the syphilitic infection. Mercury may be used in the form of fumigations, in conjunction with the vapor-bath, in many cases where it cannot safely be taken internally. The iodide of potassium, in moderate, or, if need be, in very large doses (forty to sixty grains a day, combined with sarsaparilla, or other medicines that tend to strengthen the patient, is often of the greatest benefit. Locally leeches are seldom required. Soothing applications may be had recourse to if the pain is severe, but rest of the limb by means of splints, and mild counter-irritation, are the remedies most frequently of service.

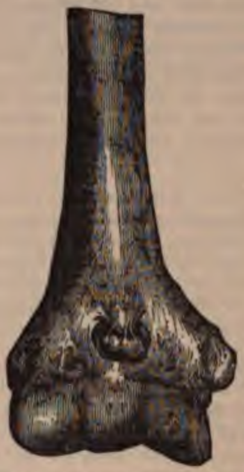
[The syphilitic affections of the joints are either directly due to the presence of a tertiary deposit in the vicinity, causing an effusion in the joint, or they are simply a synovitis occurring in a syphilitic person—in which latter case they scarcely differ from the so-called "scrofulous" or rheumatic synovitis. G. Bouilly,[1] Cottin,[2] and Mollière[3] report cases cured by the administration of iodide of potassium in large doses. Volkmann[4] mentions a poly-articular synovitis apparently arising from syphilitic poison, and this form is more common than caries.[5]]

"*Loose Cartilages*" *in Joints.*

We occasionally find in some of the articulations small movable bodies, which may be quite free, or still attached to the walls of the joint by narrow pedicles, and to which the name of "loose cartilages" has been given. These bodies, which are usually met with in adults rather than at an earlier period of life, vary in their structure; some are comparatively soft, of a yellowish color, and resemble masses of fibrin; in other cases, they are hard and glistening, rather white than yellow, and evidently composed of cartilage or fibro-cartilage, both on the surface and in their interior; frequently, too, they are partially, or sometimes almost completely, converted into bone. In many cases we find only one such body in a single joint, but it is by no means uncommon for two or three to be present, and occasionally they are met with in much higher numbers. Morgagni, for instance, discovered twenty-five smooth and polished globular bodies in the left knee of a woman who died of apoplexy. They vary considerably in size, being sometimes no larger than a barleycorn, whilst in other cases they may nearly equal the patella itself in their dimensions. When small they are usually round or oval; when of considerable size they may be elongated, flattened, or tuberous. The most common situation for these "loose cartilages" is the knee; but they are not confined to that joint; they have also been discovered in the other articulations, including even the hip, which was long supposed to be exempt from them.[1]

"Loose cartilages," in many cases, at any rate, appear to take their origin from the small irregular projections which naturally exist in connection with the "vascular processes" of the synovial membrane. In certain abnormal conditions these processes increase in size and solidity, and may ultimately become detached from their connections, so as to form separate bodies, which are perfectly

Fig. 665.



Cartilaginous growth connected by a narrow pedicle with the coronoid fossa of the humerus. (From a preparation in the Museum of St. George's Hospital. Series iii., No. 145.)

[[1] Revue des Sciences Med., Jan. 15, 1880, p. 255.]

[[2] France Médicale, July 19, 1879.]

[[3] Lyon Médical, Dec., 1879.]

[[4] Billroth and Pitha's Handbuch der Chirurgie.]

[[5] Weil, Centralblatt f. Chirurgie, No. 21, 1877.]

[1] See Archives générales de Médecine, tome xii. (1846), p. 363. [A case reported by Foucher, Nouveau Dict. de Med. et de Chir., vol. iii., p. 355; Nicaise (Diagnostique des Maladies de la Hanche, p. 105) mentions a case reported by Cruveilhier, where 15 free, small cartilaginous bodies were found in the hip-joint of a girl who had suffered for 10 years with occasional pains and stiffness in the hip.]

free in the joint, or they may still remain connected with the parietes by an elongated pedicle. They are composed of "connective tissue with elongated nuclei, and coated with epithelium, and, though not always, contain a variable number of scattered fat- and true cartilage-cells; and they are not developed externally to the synovial membrane, but from an outgrowth of that membrane itself."[1] Occasionally we find imperfectly-formed bone in the substance of the masses, derived probably from a further stage of conversion of the cartilage, or they may be bony throughout. According to Dr. R. Adams, these foreign bodies, which may be supposed usually to take their origin from the synovial membrane, are especially connected with the condition constituting *chronic osteo-arthritis*, though it is not denied that they are seen in articulations which present no trace of that disease. It is probable, however, that the detached bodies found in joints may have more than one origin; occasionally, perhaps, they may result from a blood-clot which has lost its coloring matter, and now consists only of fibrin; and in many instances they can be traced to an accident by which, probably, a portion of cartilage or fibro-cartilage has been detached, and which may, after a time, become smooth from long-continued friction.

In support of this view, Mr. Brodhurst[2] relates an interesting case in which, six weeks after the accident, he removed from the knee-joint a "loose cartilage," which proved to be the anterior portion of the internal semilunar cartilage, retaining in every respect its normal appearance.

A "loose cartilage" may exist in the joint for a length of time without producing sufficient disturbance to attract the attention of the patient, or to make him think that he is subject to anything more serious than occasional rheumatic twinges. At last, however, in some movement of the joint, the foreign body slips between the articular ends of the bones, and then a violent and sudden pain is experienced, with inability to use the limb, which remains fixed in the position which it may have happened to assume at the time. The pain continues until the "cartilage" is dislodged by some means, when the immediate symptoms at once subside, though they are often followed by inflammation of the synovial membrane, accompanied with effusion. The character of the suffering in these cases is peculiar, being often sufficient to make the patient fall, or even to occasion syncope, and is probably due to the sudden stretching of the ligaments caused, in the case of the knee-joint, by the tibia and femur being forcibly separated when the loose cartilage gets between their articular ends during flexion, and is accidentally caught during extension, before it has time to slip aside. The attention of the surgeon is now called to the part, and, on careful examination, he may succeed in discovering a firm extraneous body in the joint, which slips beneath the finger, to be lost beneath the patella or the tendinous structures above or below that bone. When the symptoms described have once occurred, they may be repeated at varying intervals; in some cases recurring on the slightest movement, and even during sleep, whilst in others they may be kept in check so as to give rise to but little practical inconvenience. If the attacks are frequent, however, the joint suffers sooner or later; the ligaments become relaxed, disease extends to the harder tissues, and the articulation is permanently injured. Many of the symptoms produced by a "loose cartilage," it may be mentioned, are occasionally met with as the result of partial dislocation of a fibro-cartilage in the knee, as well as, more rarely, in the articulation of the lower jaw, constituting what Mr. Paget terms *locked joint*.[1] A description of this condition in the knee will be found in the essay on INJURIES OF THE LOWER EXTREMITY, Vol. I., p. 979.

The treatment to be adopted may be either palliative or radical. In the first place, however, any inflammation which may be present must be subdued, and any dropsical effusion got rid of by blisters or other appropriate remedies. When this has been done, a well-fitting elastic bandage, or still better, a back splint, which will prevent the joint from being flexed, should be constantly worn, whilst the loose cartilage may be fixed (by means of pads or strapping) to some part of the synovial membrane, in the hope that absorption may ultimately take place, as will sometimes happen. In many cases this treatment is sufficient; but in some, inconvenience is still experienced to such an extent as to suggest further operative measures. When such is the case, the extraneous substance may be removed from the cavity of the joint, either by direct or by subcutaneous incision. Both these operations, however, are attended with a very decided amount of risk, and should only be performed when the palliative treatment has been fully tried and *failed*, and the foreign body continues to give rise to active mischief. The foreign body, too, should be clearly movable, and capable of being brought to a part of the joint in which it is easily accessible. The patient should be prepared for the operation, both by appropriate diet and regimen, and also by the limb being kept perfectly at rest for a few days. The loose cartilage is then guided to that part of the joint where it is most superficial, and fixed securely, so that it may not slip out of the way during the operation. If the *direct* operation is the one adopted, the parts over the foreign body are now divided, and a sufficient opening made in the synovial membrane to allow the cartilage to be pressed out of the wound, without any unnecessary manipulation or disturbance of the joint. The edges are then accurately brought together by sutures or strips of plaster, and the limb kept at perfect rest on a splint; constant cold may also be applied to the joint, to prevent, if possible, the occurrence of inflammatory symptoms. In the *subcutaneous* operation, the cartilage having been securely fixed as before, a tolerably long tenotomy knife is introduced through the skin, at some few lines distance, and passed through the cellular tissue so as to make a subcutaneous incision into the joint. Great care must be taken in dividing the synovial membrane, that the foreign body does not slip aside, for which purpose it is better for the operator to secure it himself with one hand, whilst he makes the incision with the other. The loose cartilage is then pressed either *into* the aperture in the synovial membrane (as recommended by Mr. Square), or *through* it into the subcutaneous areolar tissue, and retained in either position by appropriate means, in the expectation of its becoming ultimately absorbed.

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[1] See note to Kölliker's Manual of Human Histology, vol. i., p. 328.

[2] St. George's Hospital Reports, vol. ii., p. 142.

[1] British Medical Journal, January 5, 1867.

Sir Benjamin Brodie states, in his work on the joints, that his experience does not enable him to determine which of these operations (the direct or subcutaneous), is to be preferred. According to M. Larrey, who refers to 167 published cases of removal of loose cartilages by operation, out of 131 cases in which the old or direct method was employed, 98 were successful, 5 doubtful, and 28 died; whilst of 39 indirect operations, 19 were successful, 15 failed, and 5 died. From this it would appear, as M. Larrey states, that extraction by either method is attended with decided danger; but that in the *direct* operation, the risk to life is greater than in the *subcutaneous*; while, on the other hand, in the subcutaneous operation there is increased difficulty, and consequently less chance of success. On account of the difficulty which is experienced in getting the cartilage out of the joint into the cellular tissue without an undesirable amount of manipulation, Mr. Syme recommends another method, by which, he says, he generally succeeds without risk. This consists in "making a free subcutaneous incision through the synovial membrane and cartilage, and applying a blister over the part where it is retained."

[In contrast to these figures of M. Larrey, Mr. Morgan cites 18 cases where the knee-joint was opened under antiseptic precautions, with complete success in all. The operation was undertaken in most of these cases for the removal of a foreign body.[1] This method is therefore destined to take the place of all other older procedures.

Verneuil[2] reports 53 cases of successful removal according to the subcutaneous method, 27 failures, and 10 deaths. Removal of foreign bodies by direct incision with antiseptic precautions has been successful 25 times, and there have been 2 deaths resulting from imperfect antiseptic measures. Berthenson collected 162 operations done without antiseptic precautions: 130 were removals of loose cartilages by a direct incision; there were 20 deaths: 32 by indirect incision with no deaths, but 10 were failures.[3]]

DISEASES OF THE ARTICULAR EXTREMITIES OF THE BONES.

The diseases of the joints which originate in the articular extremities of the bones are next in importance and in frequency to those which commence in the synovial membrane. It will not be necessary, however, to enter much into detail in treating of them here, as the morbid processes have been already described in a preceding essay, on DISEASES OF THE BONES. A brief notice of these affections in their relation to the joints will therefore be sufficient.

Simple inflammation of the articular ends of the bones, and its consequences.—The articular extremities of bones are liable to attacks of simple inflammation, which may result from injury, or depend on other causes. The changes which take place resemble those which result from inflammation of other tissues, when allowance is made for physical differences of structure. In favorable cases restoration to a healthy condition occurs, or the inflammatory products may give rise to

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[[1] St. George's Hospital Reports, vol. ix., 77–78.]

[[2] Revue des Sciences Méd., Jan. 15, 1880.]

[[3] Volkmann, Billroth, and Pitha, Handbuch d. Chirurgie; Brit. Med. Journ., Feb. 12, 1877.]

deposition of increased ossific material, leading to hardening and increased weight or size of the part. In less favorable cases suppuration takes place, which may be circumscribed, forming a *local abscess* in the articular extremity, or diffused in the cancellous tissue, as in *osteo-myelitis*.

Local abscess of bone is usually found in the head of the tibia, and, as a general rule, is recognized and remedied before the articulation is affected. If not, the synovial membrane becomes inflamed from time to time; and if the original mischief is still allowed to remain, the matter may at last make its way into the joint, giving rise to suppuration in that cavity. For a detailed description of the symptoms and treatment of *local abscess in the cancellous tissue*, as well as of *osteo-myelitis* (which may in like manner lead to a discharge of pus into the nearest joint-cavity), the reader is referred to the essay above mentioned.

The inflammation may lead to the death of the whole or a part of the articular extremity, constituting *necrosis*. If the dead portion is limited in its extent and situated near the surface, the articulation may escape with little or no damage, and the sequestrum separate or be removed by operation. Sometimes the necrosis is deep-seated, presenting then many points of resemblance with local abscess of bone, like which it may lead to destructive inflammation of the joint. In some of these cases the true state of things is only recognized when death or amputation allows the parts to be dissected; in others, however, a similar operation to that required for local abscess can be performed, the dead bone is removed, the pent-up matter evacuated, and the joint is saved. Sometimes the whole or the greater part of the head of the bone dies, giving rise, of course, to rapid destruction of the joint. As no hope can exist of saving the joint in such cases, its removal, when practicable, becomes the only course to be pursued. In early life, it should be noticed that the *epiphysis* may be separated from the shaft of the bone, and lie loose in the joint, as the result either of acute or chronic disease. In such cases removal of the detached epiphysis will probably often be sufficient, should the true state of the case be detected, which may sometimes happen, though there are no very positive symptoms to distinguish this from other forms of death of the articular extremity. In necrosis affecting the very small joints, such as those of the fingers and toes, the amount of constitutional disturbance involved is so slight that we may wait, if we think it expedient, for the natural separation of the parts. In this way a sufficiently useful thumb or great toe may be preserved, the superficial position of the articulation facilitating the removal of the dead bone.

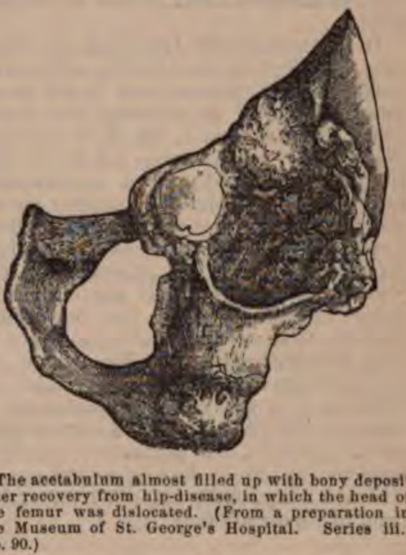
Finally, instead of death occurring in obvious masses, the inflammation may lead to a molecular destruction and removal of the osseous tissue, by a process analogous to ulceration, which is termed *caries*. Caries of bone in the vicinity of joints may arise from simple inflammation; it occurs, however, so much more commonly as the result of a low form of inflammation usually described as *scrofulous*, that it is convenient, practically, to defer its consideration, or to merge it in the description of the latter form of disease, to which we now proceed.

Scrofulous inflammation of the articular ends of the bones. — The pathological changes involved in this action, so far as the bone is concerned, are described in the essay on DISEASES OF THE BONES; they need not be recapitulated here. Suffice it to say, that we find the affected bone more vascular than natural (at least at first), then light and oily, as well as unusually soft, so as to admit of being cut with a knife, the cancelli being dilated and filled with a jelly-like substance. This form of inflammation is much disposed to lead to caries. Caries, when affecting the articular extremities of the long bones or the cuboid bones, such as those of the tarsus and carpus, commences frequently in separate points of the cancellous tissue, which gradually extend, and so approach the surface. At last the periosteum itself is reached, and implicated; it becomes detached from the osseous substance beneath, which is left rough and worm-eaten on the surface, bleeding freely, and giving exit to a foul discharge, in which are contained particles of disintegrated bone. The soft parts around share in the diseased action. Serum and lymph are effused into the neighboring areolar tissue, giving rise to a characteristic firm and elastic swelling; at a later period suppuration occurs, and the tissues are traversed by sinuses.

When the disease is situated sufficiently near a joint, the articular cartilages in the immediate vicinity of the inflamed bone become affected; their nutrient supply, as far as the osteal vessels are concerned, is interfered with; their adhesion to the bone is impaired, and they become fibrous and ulcerate, the change commencing usually on their deeper or attached surface; or portions of them may become detached, and ultimately be found loose within the joint. The synovial membrane participates in the inflammation, which may either spread to it from the diseased cartilages, or may affect it more directly by extension from the periosteum to that part of the synovial capsule which invests the bone to a certain extent before it becomes united with the cartilage and perichondrium. It may be remarked that the affection of the articular ends of the bones sometimes assumes a peculiar form, which has received the name of "*spotted ulceration*," but which is probably a variety of the strumous disease. When this is the case, several pits or depressions, containing a curdy matter, are found in the articular surfaces, the cartilages presenting a series of defined orifices, corresponding to the pits in the bone, their intervening structure remaining frequently unaltered. The diseased action, which has been supposed hitherto to be confined to one side of the joint, now becomes diffused; the inflamed synovial membrane goes through the series of changes which have already been described under the head of synovitis; the articular cartilages on the opposite side of the joint become affected, they speedily ulcerate, and the cancellous structure of the bone on which they rest is exposed. The disease gives rise to the formation of matter within the joint; but suppuration, it has already been stated, takes place likewise in the contiguous soft parts. As the case progresses, the matter makes its way to the surface, it may be directly, in the immediate neighborhood of the joint, or forming tortuous sinuses, which open at a considerable distance, and give exit to a profuse discharge. When the long bones are affected, partial or incomplete luxations are apt to take place during the later stages of the malady. The disease may continue to progress till life ceases or the joint is removed; but sometimes, after dislocation has occurred, a reparative process takes place, healthy granulations arise in the bone, the synovial membrane goes through the changes tending to recovery, which have already been described, the discharge diminishes and ceases, anchylosis takes place, and the patient is left with a limb the utility of which varies much in different cases.

Scrofulous disease of the joints, commencing in the bones, as well as in the soft structures, is frequently met with in children of strumous habit, especially in those who have never thoroughly recovered from the depressing effects of some of the ailments to which they are subject. At the Hospital for Sick Children I was able, very often, to trace the attack to the weakened state of health which had remained after scarlatina or measles. In early life the disease may affect indifferently the extremities of the long bones or the cuboidal bones; but when it commences after puberty, which is sometimes the case, it shows a decided preference for the carpal or tarsal bones. The disease is very insidious in its earlier stages, occasioning little pain or inconvenience; in children, the first thing which attracts the attention of the patient in most cases is "limping" when the joints affected are situated in the lower extremity, or unwillingness to use the arm when the upper limb is implicated. It is now noticed too, perhaps, that the child selects that position which will throw least stress upon some particular joint, or that he flinches when that joint is moved or pressed upon; and that the nights are somewhat restless. At this time the little swelling which exists is mainly situated over one of the bones which enters into the composition of the articulation. As the disease advances, the joint itself becomes more decidedly implicated; it is rigid, and more or less flexed according to the care with which it has been treated; the swelling increases, and now takes more decidedly the shape of the synovial membrane, and there is usually effusion of serum and lymph into the areolar tissue over the affected bone, distending the skin, and producing a "white swelling." If the case is neglected, painful startings of the limb begin to show themselves, aggravated at night-time, and causing the child to cry out in his sleep, or to wake up with a shriek of pain. When this occurs, it shows that the articular surface of the bone is affected, and beginning to be laid bare to the joint; the "starting" becomes specially marked, too, when inflammation has extended to the opposite bone, and when, consequently, the two inflamed and sensitive osseous surfaces are subjected to mutual pressure by spasmodic

Fig. 666.



The acetabulum almost filled up with bony deposit after recovery from hip-disease, in which the head of the femur was dislocated. (From a preparation in the Museum of St. George's Hospital. Series iii., No. 90.)

contraction of the muscles. This muscular spasm is originally induced by the osteal disease; eventually, however, it reacts upon that disease, which it aggravates by the forced and violent apposition in which it maintains the inflamed surfaces. Hence the great relief to suffering so often experienced when displacement of the bones take place, under the influence of the morbid muscular contraction, after the ligaments and other retaining structures have become weakened. When this occurs, the mutual pressure of the inflamed bone-surfaces ceases, and from this period a curative process is often dated. Before this happens, however, matter has in all probability formed in or around the joint, and sinuses are produced, taking various directions in accordance with the anatomical arrangement of the part. If a probe is introduced, carious bone can sometimes be felt, but not always, in consequence of the irregular course which the sinuses often take. The integuments around the wounds are thin and discolored, the discharge copious, watery, and unhealthy. The general health by this time usually shows strong signs of breaking up, the child becomes emaciated, hectic manifests itself, profuse night-sweats occur, and, unless relief is afforded, some vital organ becomes implicated, leading to the death of the patient.

[A number of surgical writers claim that tumor albus always is primarily an epiphyseal osteitis. Volkmann goes so far as to state that fungous disease of the joint in children never begins as a synovitis.

It is undoubtedly true that the bony origin of joint diseases is frequently overlooked, and it appears that in the bone, more frequently in children, the initial lesion is to be found, but it is also undoubtedly true that cases not to be distinguished clinically from commencing fungous arthritis, have at autopsy shown nothing except the changes resulting from a synovitis.[1] It is at present impossible to classify accurately the diseases of the joints according to their anatomical lesions; enough however has been done recently to show the great importance of this, both for prognosis and treatment, for it is probable that the course is essentially different in typical cases of epiphyseal or osteo-myelitic disease, and in chronic periosteal, synovial, and periarthritic inflammations, affections having symptoms in common and usually classified under the head of tumor albus.[2]]

Prognosis.—The prospect of a successful issue to the case depends greatly on the treatment being commenced at a very early period, before the joint has become seriously implicated. It is most desirable, therefore, that any expression of pain or tenderness about a joint, or any hesitation in the manner in which it is used, should be at once attended to, and a careful examination made by a competent surgeon. In the wealthier classes this is usually done, and the progress of the case at this period can almost invariably be arrested, and a tolerably perfect cure ensured. Even when the disease has arrived at a more advanced stage, when the joint has become implicated, and suppuration has taken place, care and perseverance on the part of surgeon and patient will usually be rewarded ultimately by success; for these cases occur for the most part in early life, and "in children the plastic powers of nature are so great that recovery may take place, when in the adult any such hope can scarcely exist."[1] These observations, however, apply principally to the wealthier classes; for amongst the poor, who are struggling for their daily bread, early symptoms are generally unnoticed, and the disease has advanced to a great extent before surgical aid is invoked. Even if admitted into hospital, the patient can seldom be kept there long enough for complete recovery; moreover, the general health is apt to suffer, after a time, from the necessarily impure air of a sick-ward, and so the patient returns home, to be again exposed to the imperfect nutrition, the confined air, and the want of rest as well as of necessary comforts and appliances, which originally predisposed to the disease or accelerated its progress. Sooner or later, in all probability, he again applies to the same or some other hospital, in a still more advanced stage of the malady, from which he ultimately sinks, or has to submit to operation. If the prognosis, therefore, in the affluent classes is favorable, it is far less so among the poor and needy. Where circumstances are favorable, and the treatment commenced at an early period, a few weeks may suffice for recovery with a useful and movable limb; even when portions of the cartilage have been destroyed, the functions of the joint may still be preserved, though the time required becomes considerably prolonged. When the disease

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[[1] Boston Med. and Surg. Journal (Willard and Shakspeare), 1880.]

[[2] Lannelongue, Archives Générales, 1879; Gaz. Hebd., 1880, 3 Sept., p. 589; Duret, Progrés Médical, June 14, 1879; Volkmann, Sammlung. Klin. Vorträge, 168, 169; Duplay, Archives gén. de Méd., Sept., 1879; Berry, New York Med. Record, Jan. 31, 1880; Lücke, Deutsche Z. f. Chir., 1880, xiii., 300; Gaz. des Hôp., 1879, lii., 433.]

[1] Lectures on the Surgery of Childhood, by Athol Johnstone.

has advanced to suppuration, and sinuses have formed communicating with the joint, recovery can only be expected at the expense of ankylosis, and after the lapse of many months or even some years.

Treatment.—If inflammation is present, we have always to bear in mind that it is of a low character; it is to the relief, therefore, of the constitutional condition that our general treatment has to be mainly directed. Everything which improves the general health—whether in the form of diet, air, cleanliness, or medicine—must evidently increase the power of resisting disease locally, or of remedying its effects. The best means of effecting this improvement, however, have already been so fully described in previous essays, especially in that on SCROFULA (Vol. I.), that it is unnecessary to repeat them here; I need only remark that whatever form of tonic may be selected, it must be given for a great length of time to be of service. As Sir Benjamin Brodie directs, the steel may be administered for three or four weeks at a time, and then suspended for a week or ten days; or some other tonic substituted, if the first should have ceased to agree. Even after recovery has taken place, as the constitution is in fault, it is necessary to persevere with the general hygienic rules prescribed in these cases, if we wish to prevent a recurrence of the disease in the same or some other part.

The *local treatment*, when the disease is seen in its *first* stage, is to a great extent negative. The disease is one of defective power; local depletion, therefore, should be avoided, as a rule, though occasionally a few leeches may be employed to relieve rapidly any outbursts of acute or subacute inflammation. Cold or warm applications can be used at these times, whichever may be most agreeable and soothing to the patient. Counter-irritants, whether in the form of blisters, issues, or the actual cautery, unless in exceptional cases, are seldom required *at this period*, and, indeed, are more likely to do harm than good, by exhausting the patient. They are also objectionable for another reason: these cases usually occur in children, and repeated painful applications, with the frequent dressings subsequently required, induce fits of passion or of apprehension, which are lowering to the patient and injurious to the malady. In fact, in the treatment of children, it is of great moment for the surgeon to acquire their confidence, to inspire them with a feeling of regard and affection; and this can never be done if his visit becomes frequently associated in their mind with pain and suffering. It may of course be necessary at times to have recourse to operative measures, or thorough examinations of inflamed and sensitive parts; but if practicable, these should be done *once for all*, and usually under the influence of chloroform [or ether]. Is nothing, then, to be done locally? *Efficient and prolonged rest*, with the limb in a proper position, here as in scrofulous synovitis, is of the greatest moment, and absolutely necessary to prevent further mischief. The limb should be wrapped in a thick layer of cotton-wool, properly secured, pasteboard or other splints adapted to the form of the joint applied, and the whole secured by gummed or starched bandages, which, without being at all tight, should extend so far as to embrace the joints *above* and *below*, as well as the actual one which is diseased. It is necessary that the limb should be fixed to this extent in order that the contraction of those muscles which arise at some distance from the articulation may be prevented, and the joint kept *absolutely in a state of rest.* Support, to a sufficient extent, should be continued to the part for some time after apparent recovery. It is also desirable that the splints should be so adapted as to allow exercise to be taken, whilst immobility of the joint is maintained.

When the disease has been neglected or improperly treated in its first stage, it commonly happens that the limb has been allowed to become distorted, and more or less fixed in its abnormal direction. In such a case it is better at once to restore the limb to its proper position, of course under chloroform, and to adopt efficient means to prevent it from again becoming distorted. The expediency of this treatment depends not merely on the fact that ankylosis is to be expected (and for recovery by ankylosis to be desirable the limb must be fixed in a proper position), but also on account of its immediate influence on the disease. The painful startings are occasioned by pressure on the inflamed bone-surfaces; and so long as undue and irregular pressure is maintained by the muscles in a state of spasmodic contraction, pain must be experienced and irritation kept up. Dr. Bauer has proposed to divide the tendons of the contracting muscles independent of any malposition, as a means of relieving the starting pains; and such a plan might not unreasonably be adopted if all milder means of relief should prove unavailing. Supposing the disease to be situated in the lower extremity, a long splint is often employed with great advantage as far as mere rest is concerned, but with comparatively little power of relieving articular pressure. For this latter purpose Sir Benjamin Brodie suggested the application of a moderate but constant extending force, by means of a weight attached to a string, passing over a pulley fixed at the bottom of the bedstead, the other end of the string being secured to the limb, whilst counter-extension was kept up by straps, which prevented the body from slipping down in bed. Of late years extension by weight has come pretty freely into use both in America and this country, in consequence of the advantages which it presents, and the facility with which it can be applied. In Mr. Holmes's Surgical Treatment of Children's Diseases, and in some papers by Mr. Marsh, in St. Bartholomew's Hospital Reports, the subject will be found fully discussed; but I may, perhaps, be allowed briefly to illustrate the plan of treatment by means of a case now under my care at the Brighton Hospital for Sick Children.

A girl about six years of age was admitted with neglected hip-joint disease in the second stage. Thigh much flexed and rigid. Knee turned inwards. Pelvis and spine much twisted. No sinuses or other indications of matter, but painful nocturnal startings, and shrieks when the limb is touched. A broad strip of adhesive plaster was applied on either side of the leg from the knee downwards, forming a loop or stirrup some three or four inches below the foot: a flat piece of wood, broader than the foot, was inserted between the two lateral portions of plaster, so as to spread them out and prevent pressure on the malleoli. The plaster was further secured to the limb by two or three circular pieces of strapping, and a light bandage. A stout iron skewer was then passed through a common reel, and the skewer suspended by a couple of straps to the bar at the foot of the child's crib, so that the pulley formed by the reel was opposite the sole of the foot. A bag containing four pounds weight of lead was then fastened to one end of a small chain, the other end being free for the purpose of being fastened to the stirrup of plaster when required.[1] When all was ready, the child was placed under chloroform, and the pillows removed so that she lay flat on her back. On making gentle extension on the thigh, the muscles began to yield quietly, and then one end of the chain, passed over the reel, was hooked on to the stirrup, the four pound weight hanging to the other end some distance from the floor. Straightening of the limb progressed steadily and visibly, and, as this was going on, a long splint was fastened to the opposite or *sound* side of the patient, to correct the lateral twisting of the body and also to prevent any sudden jumping up in bed under the influence of fright. The hip was enveloped in cotton-wool; sand bags were placed on each side of the limb for support; the lower end of the bedstead was raised about three inches by pieces of wood, in lieu of counter-extension, to obviate any chance of the body slipping down; and finally a cradle was placed over the foot to keep off the weight of the bedclothes and prevent eversion. When the effects of the chloroform had passed off, the limb was nearly straight, and the child made no particular complaint of pain, but was cheerful and took her meals. There was some "starting" on the following night, but less than before, and the next day the child was comparatively comfortable and happy.

In the second stage of joint disease, counter-irritation is more often required than in the first. The most generally beneficial form, I think, is the steady and continued use of warm applications over a large surface of skin. Iodine is often of service, and blisters occasionally, though these last had better be employed with care and caution in children. Severe pain, continuing after the limb has been properly secured and sufficient extension made, is often relieved by a few lines of the actual cautery.

In the third stage, when matter is forming, the limb must still be retained in a state of perfect rest and extension. Hot applications, or, perhaps, the actual cautery may be employed, but the pain often continues unrelieved till the matter is evacuated by incisions, or has made its own way through the ligamentous structures towards the surface.

If the case progresses favorably, and the sinuses contract and close, the treatment consists in the same local measures as those which have already been pointed out in the section on *strumous synovitis;* but the case may not progress favorably, and it may then become a question of resorting to *operation.* It has already been stated that in early life the limb may generally be preserved. With the children of the very poor, however, especially those in large towns, and indeed at all periods of life amongst those who have to gain their livelihood by labor, this question often arises: Is the chance, or even the strong probability, of ultimate recovery with a stiffened limb, after many months, perhaps years, of confinement and forced abstinence from labor, preferable to a more immediate recovery with a loss of the limb or joint, but with all the risks attendant on a grave operation? Every case must be decided on its own particular merits; but having this consideration in view, it is evident that a surgeon is often justified in using the knife even where an operation is not absolutely necessary. When health is failing under the protracted confinement, suffering, and exhausting discharge, removal of the part often becomes advisable to *preserve life.* Now in weakly subjects, any thing which lowers the patient, or effects a drain upon the system, is prone to induce disease; the removal of the source of mischief, therefore, often saves life by preventing more important structures from becoming affected. On the other hand, it must be borne in mind that operations in strumous subjects are, in some cases, rapidly followed by the appearance of tubercle in internal organs, which did not previously exist, or, at any rate, had failed to manifest itself. In deciding the point, the surgeon will undoubtedly be influenced by the position and importance of the diseased part, and the consequent severity of the operation required. To expedite the patient's recovery, he would promptly remove one or several of the tarsal bones, when he would hesitate about amputating the thigh, or excising the head of the femur.

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[1] Fig. 211, Vol. I., p. 947, will illustrate this apparatus.

The comparative merits of amputation and excision have been discussed already. (See the essay on EXCISION.)

The articular extremities of the bones are liable to *rheumatic inflammation*. In the essay on DISEASES OF THE BONES, the subject of *rheumatic osteitis* is described; and its relation to diseases of the joints is further discussed in the sections on Chronic Rheumatic Synovitis and Chronic Osteo-Arthritis, to which the reader is referred.

The joints may also suffer from syphilitic inflammation commencing in or extending to the bones. For this also the reader is referred to the essay on DISEASES OF THE BONES; and some further remarks on the subject will be found under the head of syphilitic synovitis.

Rachitic affections of the articular ends of the bones.—The bones are materially affected in the constitutional derangement giving rise to rickets. This condition, which is sometimes supposed to be of modern origin, though the lines of Martial[1] would seem to show that it could not have been unknown in his time, is described in another part of this work.[2] It is only necessary to remind the reader here, that though the alterations which occur are specially manifested in the *shafts* of the bones, yet the articulations do not entirely escape. In the early stage of rickets the "knots" or swellings which take place in the osseous or cartilaginous ends of the bones are highly characteristic of the affection. At the anterior extremities of the ribs these enlargements are particularly obvious, affecting both the bone and the cartilage, and giving rise to an angular projection of the costochondral articulations. At a later period these articulations become much weakened, and permanent alteration of shape occurs. Sometimes the rib projects, and the cartilage is forced inwards; more frequently it is the rib which is driven inwards, and the cartilage is dislocated on its external surface, a connection between the two being still maintained by ligamentous tissue. If the chest is examined, the extremities of the ribs will be found presenting a row of nodosities, the sides of the thorax are hollowed, the thoracic capacity diminished, and the function of respiration interfered with to a more or less serious extent. In the limbs, similar nodosities are met with in the articular extremities of the bones, first appearing in the lower ends of the radius and ulna, as well as in the malleoli, and afterwards affecting the knees and elbows. As the disease advances, the shafts of the bones undergo the alterations described elsewhere, the bending of the diaphyses occurring more frequently, as well as at an earlier period, in the lower than in the upper extremities. The articulations participate more or less in the deformity, being often twisted in an opposite direction to the curvature which the limb has assumed. The ligaments yield, and incomplete dislocations are apt to take place. At the knee, for instance, displacement may occur outwards or inwards, resulting from a partial yielding of the articular extremities of the femur and tibia, itself induced by the unequal distribution of the weight of the body on the surfaces at the joint.[1]

The nature of the affection, when the joints are implicated, can scarcely fail to be recognized, in consequence of the rickety condition of other parts of the osseous system, and the period of life at which it occurs. The treatment in these cases is mainly constitutional, to remedy, if possible, the specific diathesis: cod-liver oil, probably, being the medicine which is most generally beneficial. Locally, it is advisable in most instances, when the articulations are disposed to yield and to become distorted, to apply mechanical support of such a nature as to counteract the tendency to displacement, and allow of exercise being freely taken. The articular deformity in this way is often relieved, and the results obtained are tolerably satisfactory.

Tumors of the articular ends of the bones.—In the essay on DISEASES OF THE BONES an account of the new formations which occur in connection with the osseous system has been given. If the articular ends are involved, the joints may evidently become affected either by their movements being mechanically interfered with, or, in the case of cancer, by extension of the disease to other structures, and consequent disorganization of the articulation. The symptoms, therefore, produced by these formations, especially the malignant, present certain points of resemblance with those of other diseases of the joints, which may be briefly noticed. In some cases, the nature of the tumor for various reasons is obvious enough, and no difficulty arises in the diagnosis, but this is far from being generally, or even usually the case; the rules, however, by which we are to be guided are laid down in the essay to which the reader has already been referred. The form of malignant disease most frequently met with is the soft or medullary, and according to Rokitansky it never commences, as a primary disease, within or upon the synovial membrane; the same remark applies with increased force to the cartilages, for the cartilaginous structures are sometimes found intact when every other part of the joint has been destroyed.[1] Whatever may be effected in the case of innocent formations, in malignant affections the only chance of relief consists in amputation, which should be performed, if possible, so as to remove the whole of the affected bone. Even when this is done, the chance of permanent success is far from great; but amputation involving the retention of any portion of the cancerous bone is next to hopeless. Obviously, therefore, it is desirable to ascertain in which of the bones the disease began; and by attending to the point where the swelling first manifested itself, this can usually be determined.

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[1] Cum sint crura tibi, simulent quæ cornua lunæ,
In rhytio poteras, Phœbe, lavare pedes.

[2] See SURGERY OF CHILDHOOD.

[1] See Bouvier, Sur les Maladies chroniques de l'Appareil locomoteur.

Abnormal Conditions of the Articular Cartilages.

The articular extremities of the bones are protected by a thin layer of cartilage, one surface of which is firmly connected with the bone, whilst the other is free in the joint, except near the circumference, where it is covered by an extension of the periosteum, forming a special coat—*perichondrium*—which gradually terminates on the cartilage, without any well-defined border. It is to this perichondrium that the portion of synovial membrane which advances over the edge of the cartilage is inseparably united.

The articular cartilages, when fully developed, contain neither nerves nor bloodvessels, and yet they are living tissues, though simple in their structure. Nutrition in them, as in the cornea, is not effected directly through the means of bloodvessels, but results from the conveyance of the nutrient materials from cell to cell. The cartilage-cells retain their powers of reproduction; old cells disappear and are replaced by new ones, and so a round of nutritive changes takes place adapted to serve the wants and maintain the integrity of the tissue. The nutrient materials are obtained from the bloodvessels of the synovial membrane and of the bone; in both cases there exists a free vascular supply in close proximity to the cartilage, round the circumference of which are arranged the *plicæ vasculosæ* of the synovial membranes; whilst we find in the bones, beneath the cartilaginous surface (the *articular lamella*, however, intervening), vascular convolutions, dilatations, or plexuses, specially adapted for the reception of the blood and separation of its plasma.

The functions of articular cartilage are comparatively mechanical, intended as it is by its smoothness and elasticity to diminish friction and obviate the "jar" or shock to the bones, which would otherwise give rise to frequent fractures. Even for these purposes, however, it is necessary that a certain amount of vitality or nutritive power should exist, else the cartilage would gradually wear away in proportion to the amount of friction it has to sustain, and that we know is not the case; for if articular cartilages are somewhat thinner in the old than in the young, the change is not greater than that which is known to occur in other tissues of unquestionable vitality.

So long as the natural processes of nutrition and secretion, as well as the disturbed processes of inflammation, were attributed entirely to some mysterious action on the part of the bloodvessels, the healthy and diseased conditions of the non-vascular tissues scarcely allowed of explanation. But when we admit the nutritive power of the cell- or germ-constituents of the tissue itself, and consider the vessels as intended to bring supplies of prepared nutriment into sufficiently near relation to them, much of the difficulty vanishes. In perfectly developed articular cartilage we have permanent nucleated cells contained in their capsules and imbedded in an inter-cellular substance; and if we have no vessels in the cartilage itself, they exist in sufficiently close proximity to the tissue for the elements they contain to be within reach of the more direct agents of nutrition. Such an arrangement would be insufficient for organs in which intense action is going on; but for the passive cartilages, the bloodvessels of the bones on which they rest, and of the synovial membranes which surround their circumference, afford a sufficient supply of nutritive material for the cartilage-corpuscles to maintain the integrity of the tissue. If this supply is interfered with, if the circulation in the bone or in the synovial membrane is disturbed beyond a certain point, we can understand that the nutrition of the cartilage should be prone to suffer, and so we find this tissue very liable to be affected *secondarily* in consequence of inflammation, common or specific, occurring in the synovial membrane or in the articular extremity of the bone. Its nutrition, however, may also become abnormal, directly or primarily, from some disturbed action in its own elements, and we have disease of the cartilage, attended with great alteration of structure, where the neighboring tissues exhibit little or no sign of disease.

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[1] See Virchow, Cell. Path., Lect. xix.

Articular cartilage then is so far under the influence of the laws which regulate vital tissue as to be at once capable of maintaining its own status during health, and of undergoing changes, many of which are analogous to those termed inflammatory, in a state of disease. Thus cartilage will maintain itself in its usual condition during a long life; it may be hypertrophied or atrophied; it may degenerate, may ossify, or perish; it may also ulcerate, and probably suppurate.[1]

Hypertrophy.—Articular cartilages, it is said, are occasionally found to present an increase in their substance without any obvious change in their actual texture. Such a condition, however, appears to be very rare; for, as a general rule, when the cartilage is thicker than natural the tissue is soft and spongy, with a tendency to break up into fibres, exhibiting, in fact, obvious marks of disease.

Atrophy.—Simple wasting of the tissue in cartilage occurs more certainly than simple hypertrophy. In advanced life, and especially in those joints which are subjected to the greatest amount of pressure, such as the hip, we find the cartilages gradually thinned, their structure in other respects remaining healthy. The process is, of course, a slow one, advancing gradually with age, and constituting, in fact, little more than a sign of natural decay. True atrophy, in most cases, affects the whole surface of the cartilage; but a partial thinning is met with in comparatively early life, accompanied usually with sufficiently marked traces of previous disease to distinguish it from simple wasting.

Gouty deposits in cartilage.—In old and gouty subjects we sometimes meet with a peculiar change in the articular cartilages, resulting from the deposit in their substance of urate of soda. This salt is found not merely on the surface of the cartilage, but also in the inter-cellular substance, through which it is diffused, sometimes to such an extent as almost to supersede the normal structure, which then presents the appearance of a chalky mass. The predilection exhibited by the gouty material for this tissue is further shown by the frequency with which it is deposited in the cartilage of the external ear as well as in the articular cartilages.

Fatty degeneration of cartilage.—In advanced life, in joints which have long been disused, and under other circumstances unfavorable to healthy nutrition, articular cartilages sometimes undergo a process of degeneration corresponding to the analogous affection of the cornea, which passes by the name of *arcus senilis.* In such cases we find the whole or part of the articular surface presenting a series of fibres, free at one extremity where they project into the articulation, and attached at the other to the remaining cartilaginous tissue, exhibiting, indeed, somewhat the appearance of velvet. The cartilage is often thickened and pulpy, and much softer than natural, or it may appear rough and fibrous.

Ossification of cartilage.—Many cartilaginous structures have a natural tendency to ossify as age advances, and we find the costal cartilages usually, and the thyroid and cricoid cartilages occasionally, undergoing this change, which represents in them a form of degeneration or decay. The articular cartilages, on the other hand, are by no means prone to such a transformation; for, when the developmental ossification is completed, any further tendency in this direction appears, as a rule, to be permanently arrested in the cartilage which remains beyond the articular lamella. Under certain circumstances, however, articular cartilage becomes converted into bone. This change, occasionally met with in the aged, is obvious enough at times during the progress of *chronic osteo-arthritis;* for in joints suffering from the affection, the place of the entire cartilage may be occupied by a particularly dense kind of bone, in which the Haversian canals are filled with calcareous matter; or portions of the cartilage may be replaced by this ivory or porcellanous material, which remains on a level with the remaining cartilaginous structure.[1]

Ulceration of cartilage.—It has been already stated, in accordance with the opinion of Weber,[1] that articular cartilage, like the cornea, is very liable to an altered condition of nutrition, which may fairly be called inflammatory; a condition which shows itself principally in the form of ulceration. The researches of Goodsir and Redfern, followed by those of still more recent authors, have shown that the changes in ulceration arise immediately from a vital alteration occurring in the cartilaginous structure itself, and that the influence of the neighboring bloodvessels is only indirect or secondary. When the disease is peculiarly active, almost the whole of the cartilage may disappear, a few isolated patches, which are usually reddened, alone remaining. In other cases, the cartilage is softened and abraded; or it appears as if portions of it had been scooped out, leaving smooth pits or depressions. Ulceration usually begins on the free surface of the cartilage; it may commence, however, on its attached surface, or even in its substance.

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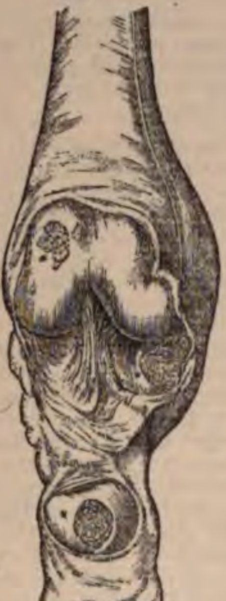
[1] See Weber, Ueber die Veränderungen der Knorpel in Gelenkkrankheiten, Virchow, Archiv, January, 1858.

[1] See the section on Chronic Rheumatic Synovitis and Arthritis.

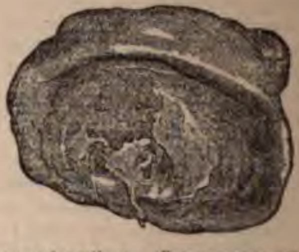
Fig. 667.



Incipient ulceration of cartilage. (Museum of St. George's Hospital.)

If we examine the change as they occur on the free surface after synovitis, we notice that the color of the cartilage is altered in spots, which either rapidly become holes, looking, to use Sir Benjamin Brodie's expression, "as if they had been cut out with a chisel," or the spots assume a fibrous aspect, becoming gradually excavated, so as to form pits or depressions with fringed margins. Such a condition may be found destroying the cartilage extensively, and even laying bare the bone, without the presence of any membrane. In many cases, however, and especially in scrofulous synovitis, we find a thickened or newly-formed vascular membrane extending from the diseased synovial capsule over the cartilage. Such an extension, indeed, may occur without any ulceration resulting; or even when the cartilage is affected, the excavations are not at first necessarily in connection with the membrane, for they may be found in situations to which the membrane has not extended. As the disease goes on, however, the cartilage, according to Mr. Barwell[1] (in his description of the changes occurring after strumous synovitis), slowly undergoes a transformation into a form of granulation, between which and the similar material growing from the synovial membrane adhesions form, resulting at last in absolute continuity. If the ulceration extends deeply, the bone beneath participates in the disorder, its vascularity is increased, and at last the cancellous tissue becomes inflamed. The articular lamella crumbles, or gives way in masses, carrying with it portions of cartilage, which may still be comparatively sound; and the granulations which spring from the exposed cancellous tissue unite with those of the synovial membrane. When the disease originates in the bones, and extends to the cartilage, the first process, according to Mr. Barwell, is one of simple degeneration, followed usually by true inflammatory ulceration. A portion of the cartilage, losing its nutrient supply, degenerates or perishes, and is detached with its articular lamella from the inflamed surface of the bone, whilst the surrounding portions of cartilage undergo

Fig. 668.



Ulceration of cartilage. (From a preparation in the Museum of St. George's Hospital.)

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[1] See Weber's paper in Virchow's Archiv for January, 1858.

[1] Barwell, On Diseases of the Joints, p. 113.

the changes described as occurring in ulceration after synovitis. Inflammatory ulceration of the cartilages, unaccompanied with disease of any other joint-tissue, may *possibly* take place, though cases of it are not easily met with; degeneration, on the other hand, being of comparatively frequent occurrence.

[Primary ulceration of the cartilage unconnected with disease of the bone or synovial membrane has, according to Hueter, never been demonstrated.

Sir Benjamin Brodie claimed to have shown primary ulceration of the cartilage, but failed to make a sufficiently thorough examination of the bone to exclude osteal origin of the disease.[1] Panas[2] claims to have frequently seen erosion or ulceration of the cartilage unconnected with a lesion of the bone or synovial membrane, in cadavers perfectly normal in other respects, but he thinks there is no reason to believe that tumor albus originates in either disease of the cartilage or ligaments.[3]]

When the cartilages have been extensively destroyed and the cancellous bone-tissue on each side of the joint exposed, repair, if it occurs, takes place by granulation-tissue uniting the opposing surfaces, and producing ankylosis in the manner already described. Or the ankylosis may be incomplete, portions of cartilage still remaining unaltered. In slighter cases, a natural cure may occur after ulceration has gone on for some time, and affected the cartilage to a considerable depth. This takes place, as Dr. Redfern points out, "by the formation of a fibro-nucleated membrane from the substance of the cartilage, without the occurrence of any new exudation." Occasionally we find a patch of ivory deposit occupying the place of some portion of the cartilage, or there may be simply a scar left, marking the place where the ulcer had existed. To complete the sketch of the changes which this tissue undergoes, it may be stated that, in cartilage, malignant affections are so rare that it is usually assumed to be altogether insusceptible of them.[4] For this insusceptibility Virchow gives reasons, founded on his views of the transference of the infection, by means of morbid juices, to the anastomosing elements in the neighborhood.

Symptoms.—Lesions of cartilage may occur primarily or secondarily. As primary affections, we frequently find after death well-marked "ulceration" where no symptoms had been noticed during life, excepting, perhaps, occasionally, a certain amount of "crackling" or "grating" in the joints. These cases are of course chronic in their character, and the affection is of the nature which has been described under the head of degeneration. True "inflammatory" ulceration is almost invariably secondary, the consequence of inflammation, common or specific, occurring originally in the synovial membrane or in the bone. This affection may be acute or chronic in its progress. Sir W. Lawrence[1] relates the case of a patient who died after venesection, in whom, as he believed, complete destruction of the articular cartilages of the femur and tibia took place in four days. In most cases, however, it is much slower in its progress; and in some, especially in old disease of rheumatic origin, it may be extremely chronic in its character.

Degenerative ulceration of cartilage is attended with no marked symptom, gives rise to no pain. Is pain produced by "inflammatory" ulceration? The deservedly great authority of Sir Benjamin Brodie for a long time connected with ulceration of the cartilages those severe pains which are increased at night-time, aggravated by any motion, and attended with involuntary startings of the limb. The fact, however, that no nerves can be discovered in articular cartilage, even with our present improved powers of investigation, renders such a view almost inadmissible, unless we conclude that our means of investigation are still too defective to warrant our placing trust in them. In his last edition, however, Sir Benjamin Brodie avows that he is "inclined to the opinion that the increased sensibility in these cases is in the bony plate beneath the cartilage, rather than in the cartilage itself; and that the presence of severe pains with involuntary startings of the limb, is always to be regarded as a sign of the bone partaking of the disease." We may assume then, that disease of articular cartilages is attended with no distinctive or characteristic symptoms (if we except the "crackling" on motion, mechanically attendant upon a loss of smoothness of their surface). In cases of disease commencing in the synovial membrane, when starting pains come on, it may be taken indeed as evidence, not merely that the cartilages are affected, but that the disease has further extended to the bone. When the disease, on the other hand, has com-

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[[1] Surgical Diseases of Children. T. Holmes.]

[[2] Nouveau Dictionnaire de Méd. et Chirurgie: Articulations.]

[[3] Alteration in Cartilage in Chronic Disease of Joints. Ziegler, Med. Central Zeitung, May 8, 1878.]

[4] See Chance's edition of Virchow's Cellular Pathology.

[1] Lectures on Surgery, Lancet, 1829–30.

menced in the bone and involved the cartilages, the joint may speedily become opened; and the suppuration and abscess which occur there are attended with the symptoms which have already been pointed out. The treatment, as well as the diagnosis of diseases of articular cartilage, so far as they can be ascertained, will be found in the description of the affections of the other structures of the joints.

[AFFECTIONS OF THE JOINTS SECONDARY TO CHANGES IN THE SPINAL CORD.

Articular affections dependent upon and secondary to lesions in the spinal cord have been demonstrated by Charcot, Ball, Allbutt, Raymond, Hitzig, and others. The pathological changes are directly dependent upon the changes in the cord, and are said to have been observed after injuries of the peripheral nerves, cerebral apoplexy, acute myelitis, tumors in the gray substance of the cord, and in Pott's disease. The most common spinal arthropathy is that following degeneration of the posterior columns, or locomotor ataxy, and is characterized by a hydrarthrosis, together with a diffused swelling of a hard consistency, involving the tissues about the joint, and without the ordinary symptoms of œdema. The joint is distended with fluid, but the swelling is not limited to the cavity of the joint, and hence the characteristic appearance observed in hydrops articuli is wanting. The course of the affection is varied. The swelling may disappear suddenly after a few weeks' or months' duration, without any injury to the joint, or erosion and absorption of the articular ends of the bone may follow, with luxation of the bones and total destruction of the joint. Suppuration has been observed, but is exceptional. The disease is always an early phenomenon, occurring between the prodromal period and that of inco-ordination.

The knee is the joint most frequently affected, then follow in order the shoulder, the elbow, hip, wrist, and smaller joints. Several joints may be affected at the same time.

"Certain arthropathies," to quote the opinion of Vallin, "are only the local expression of a trouble of nutrition, with its origin in a lesion of the cord; they are frequently confounded with traumatic joint affections, but a difference exists which permits a diagnosis."[1]]

DISEASES OF OTHER TISSUES IN AND AROUND THE JOINTS.

We have seen that the diseases of the joints, which I have attempted to describe, are prone to affect in their progress the soft structures in the neighborhood. The ligaments become relaxed and weakened; the muscles contracted; the areolar tissue forms the seat of abscess, or is traversed by sinuses; and the skin itself may be ulcerated or destroyed. The morbid action, on the other hand, may *originate* in the peri-articular structures, and either simulate disease of the joint or lead directly to it. The variety of these lesions is so great that it is impossible, within the limits of this essay, to attempt a detailed examination of them, and this indeed would be unnecessary, as their description will be found in other parts of the work. A few remarks, however, upon the relation of each of these structures to the pathology or diagnosis of joint-disease may not, perhaps, be considered out of place.

Diseases affecting the Ligamentous Structures.

The ligaments and fibrous structures around the joints are no doubt liable to inflammation, acute or chronic, in consequence of the injuries which they sustain from sprains or other accidents (see the essays on injuries of the different regions). Slow to inflame, the reparative process appears to be slow also; for it frequently happens that the movements of a joint are hampered, and its use attended with great pain for a long time, after a comparatively slight injury, in which the ligamentous or tendinous tissues alone have apparently been injured. Opportunities of examining the parts in these chronic cases have not often been afforded, or have not, at least, been often made use of; but occasionally the ligaments have been found thickened and pulpy, independent of any actual laceration of their substance. From the frequency with which chronic or "strumous" joint-disease can be traced to some slight accident or injury, it is very probable that, in some cases at all events, the ligamentous structures are the textures originally affected, and Mr. William Adams is even

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[[1] Charcot, Leçons sur les Maladies du Systéme Nerveux; Clifford Allbutt, St. George's Hospital Reports, vol. iv.; Raymond, Progrés Médical, May 27, 1876; Buzzard, Lancet, Aug. 22, 1874; Hitzig, Berliner Klinische Wochenschr., Dec. 2, 1872, No. 50; Rendes, Gazette des Hôpitaux, 1878, p. 194; Arthritis in Pott's Disease, S. W. Mitchell, American Journal of Med. Sciences, April, 1875, p. 339; Payne, Med. Times and Gaz., Nov. 20, 1880, p. 603.]

of opinion "that strumous disease commences most frequently in some of the ligaments of the joints." At any rate, in the case of the hip, the ligamentum teres and other parts of the ligamentous apparatus are found so often affected, and at so early a period, that there is much reason to believe that the disease may in many instances originate in these structures.

[Against this view may be cited autopsies where the ligamentum teres in cases of early hip-disease was not found destroyed. Further, according to Hyrtl,[1] the artery in the ligamentum teres does not supply the nutrition of the head of the femur. It does not enter the bone, but on reaching it returns back in the ligamentum teres. This opinion of Hyrtl, however, is not held by many anatomists.]

In the sketch of the advanced stages of articular disease we have seen the ligaments ulcerating or yielding, and so permitting the exit of matter from the interior of the synovial membrane, or allowing complete or partial luxations to occur. Sometimes, on the contrary, we find layers of a fibrous tissue, having somewhat of a lardaceous appearance, and occasionally attaining a very considerable thickness, developed in the ligaments or in the areolar tissue around them, and forming the immediate cause of what is termed extra-capsular false ankylosis. In rheumatic and syphilitic affections, it is probable that the ligamentous structures share in, or even originate, the diseased action, and at least contribute to the pain which is so severely felt. In gout they may form the seat in which the urate of soda is deposited. In chronic rheumatic arthritis they suffer to a great extent; the capsular ligaments may be greatly increased in thickness, or portions of bone may be developed in their substance; and in the hip the round ligament may entirely disappear, or in the shoulder no trace of the glenoid ligament be left.

The ligaments, it was said, are liable to become relaxed in the progress of articular disease; a similar looseness of them is sometimes found as a primary affection, or at least dependent only upon some constitutional condition. In persons of lax fibres, especially in delicate or hysterical young women, a preternatural mobility of the joints is not uncommon, so that extension of the fingers or thumb may be carried nearly as far as flexion, and the nails and the back of the hands be made to meet. In many cases this state is not attended with any practical inconvenience; and even where partial luxations occur, the bones return at once to their normal position. Occasionally, however, it happens, perhaps in those persons in whom the undue mobility of the joints is not attended with a corresponding relaxed condition of the muscles, that complete dislocation takes place, which may not be reduced spontaneously, but may require surgical assistance. Instances of this kind, involving an unusual liability to luxation, are frequently recorded. A similar condition of relaxation of the ligaments, involving loss of power of the articulation, and leading occasionally to luxation, may follow palsy of a limb, and is often met with as a result of infantile paralysis. In many children it is necessary to have recourse to mechanical contrivances to obviate this weakness, whilst means are being adopted to increase the muscular power by which the joint may be moved or the limb exercised. The symptoms, progress, and treatment of articular disease, as it implicates the ligaments, will be found included in the preceding sections.

[The reflex symptoms accompanying joint affections have been recently the subject of a good deal of attention.

M. Ollivier has well stated the present opinion in regard to the changes which occur:—

"Le systéme musculaire éprouve le contrecoup de presque toutes les affections qui peuvent atteindre les jointures."[1] This "contrecoup" is manifested in the early stages by what is well termed "éréthisme de la contractilité musculaire"—or to use another figure, "vigilance musculaire." This state of muscular irritability is manifested by a liability to a spasmodic contraction of the muscles, or by a resistance to passive motion, "a reluctance of the muscles to relax." This irritability may be replaced by a permanent contraction, which if persisting a long time will develop a fibrous degeneration of the muscle.

Atrophy also takes place quite rapidly, more so than can be explained on the supposition that it is caused by the rest the limb is subjected to. This atrophy is an early symptom, and may be supposed to be due to a reflex change in the trophic cells of the cord, supplying the limb, or to a change in the nerves about the joint.[2] In addition to this a diminution in the faradic muscular contractility in the muscles about the joint has been demonstrated by many.[3]

[[1] Boston Med. and Surg. Journal, May 10, 1877, p. 568.]

[[1] Thèse de Paris, 1859.]

[[2] Valtat, de l'Atrophie Musculaire dans les Maladies Articulaires, Paris, 1877.]

[[3] Webber, Putnam, Trans. Mass. Med. Society, 1878; Seguin, Shaffer, Archives of Clinical Surgery, June, 1877.]

The reflex symptoms; muscular stiffness, muscular contraction, atrophy and diminution of the elastic contractility of the muscles, are so marked that they have been considered as diagnostic of joint affections.

Some writers regard a firm contraction of the muscles, atrophy, and loss of electric contractility, as indicative of an affection of the joint characterized by an osteitis in distinction to a synovitis.[1] But the subject needs further investigation, as all observers do not agree as to the reliability of all these symptoms as a means of diagnosis between synovitis and epiphyseal osteitis.[2] The writer met with one case of osteitis, where from the rapid atrophy and muscular rigidity about the hip-joint, a chronic articular osteitis was diagnosticated; but on autopsy six months later, it was found that no disease of the bone was present, but a marked synovitis.[3]]

Diseases affecting the muscles.

The altered conditions of the muscles and their tendons by which the joints are forced into certain positions, or retained in the positions they have assumed, may be primary or secondary in their relation to the articulation. In the latter case disease commences in the joint, and the muscles are affected subsequently, contracting spasmodically from reflex irritation, so as to aggravate the symptoms and give rise to increased mischief by the inter-articular pressure they produce, as well as by the tendency to partial or complete luxation caused by the predominance of one group of muscles over its antagonists; at a later stage, too, they become fixed and rigid, so as to impede functional exercise of the joint even when the original articular affection is subdued. Hence the importance, which has already been insisted on, of early attention to the position of the limb, and the necessity of counteracting the reflex muscular action by appropriate splints or by properly applied extension. The muscular lesion, on the other hand, may be primary, as far at least as the joint is concerned; from some disturbance in the nervous system, an undue or unbalanced contraction of certain muscles occurs, and the articulation is fixed in a particular position, which becomes permanent if the muscular structure degenerates and loses its proper contractile material. Such a condition of spastic rigidity is sometimes found in the adult, the result usually of serious disease affecting the cerebro-spinal axis. It is much more common in early life, as a consequence of the infantile paralysis which, if seldom fatal, is frequently quite incurable. In many of these cases the amount of deformity which occurs is deplorable, and the malposition of the joint, so long as it lasts, obviates any hope of stimulating the muscles to contract, or prevents that exercise of the limb on which any prospect of improvement depends.

Rigidity of the muscles, terminating, perhaps, in atrophy or degeneration, is often seen when a limb has been maintained for too long a time in one position, and especially when pressure has also been exercised on the muscles and their tendons, and their action arrested by the application of tight bandages. This condition of the muscles may also be accompanied by grave mischief within the joint. After fractures requiring prolonged immobility of the limb, or at least in which the limb has been kept fixed for a length of time, rigidity of the parts takes place to a greater or less extent, and is very obstinate in its duration. In some of these cases, and especially when the patient is advanced in life, or the constitution is otherwise predisposed to such alterations, we may find, as M. Tessier has pointed out, effusion of serum, mixed perhaps with blood, into the joint, the synovial membrane at the same time being injected and its vascular fringes swollen. In other cases the mischief may have advanced still farther, and the articular cartilages have materially suffered, becoming reddened from contact with the effused blood, and softened in their structure, or presenting actual loss of substance on their surface. These changes, it may be remarked, are not confined to the articulation in the immediate neighborhood of the fracture, but extend to others which have been maintained in a similar state of fixedness. The importance of due action of the muscles need scarcely, therefore, be insisted on, or the propriety of having recourse to passive motion at the earliest period of which the case will admit.

Finally, it may be noticed that an articulation is sometimes found to be perfectly rigid, from muscular contraction, in that condition of the nervous system which we term hysterical (see Articular Neuralgia). By examining the limb, however, during natural sleep, or in the insensibility produced by chloroform, the relaxed condition into which the muscles fall, and the free movements which can

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[[1] Shaffer, Archives of Clinical Surgery; also American Clin. Lectures, iii., No. 6, June, 1877.]

[[2] Berry, New York Med. Record, January 31, 1880.]

[[3] Boston Med. and Surg. Journal, Nov. 11, 1880. See also Paget, Clinical Lectures.]

be impressed upon the joint, leave no doubt as to the true nature of the case.

The subject of undue or impaired muscular contraction, and its results, will be hereafter treated in the essay on ORTHOPÆDIC SURGERY; but it plays so important a part in articular disease, that it was impossible to avoid all notice of it in this place.

Diseases affecting the Areolar and Adipose Tissues.

The areolar tissue around the articular extremities of the bones, or over the synovial membranes, commonly participates in the diseases of these structures, and is either simply œdematous, or, in severe cases, becomes the seat of abscess or permeated by sinuses. Acute inflammation, on the other hand, not unfrequently attacks the areolar tissue in the neighborhood of joints, as the result of blows or contusions, of wounds, or of erysipelas. It occurs, too, in many cases as a secondary consequence of inflammation of the synovial bursæ. The inflammatory action frequently runs high, and there is much constitutional as well as local disturbance. The swelling is considerable, the part is hot and tender, the skin reddened, and any movement of the part, including the articulation, is attended with pain. There is usually much tendency to suppurate, and when the synovial bursæ are implicated, matter forms rapidly and in considerable quantity, presenting some resemblance to acute abscess of the articular cavity. The diagnosis, however, between this affection and disease originating within the joint, is not difficult. The rapidity with which the symptoms have come on distinguish it from disease of the bones; whilst the position of the swelling, which extends over and conceals the osseous prominences, prevents it from being confounded with synovitis. By careful manipulation, too, it will be found that the joint itself may be handled without producing pain, provided that no pressure or tension is exercised upon the inflamed parts around. This kind of inflammation is not uncommon in delicate or strumous children, in whom it is very apt to involve the articulation, unless great care is taken. The knee and the shoulder are the two situations, perhaps, in which the affection is most frequently seen.

The treatment in these cases is sufficiently obvious. The limb must be kept at perfect rest; poultices and fomentations applied; and if matter forms, early and free incisions should be made for the purpose of evacuating it, lest the pus should find its way into the synovial cavity, and the case become one of serious consequence, resolving itself, in fact, into acute suppuration of a joint. The incisions, though free, should not, of course, be so deep as to open the articulation, under the mistaken idea that this is already implicated. In strumous children the general health has to be sedulously attended to, and care taken not to depress the constitutional powers.

With respect to the affections of the adipose tissue, there is little to be said; according to Rokitansky, a branching growth of fatty tissue is occasionally met with, chiefly in the knee-joint, in the free part or in the duplicatures of the synovial membrane, corresponding to the lipoma arborescens of J. Müller.

Diseases of the Synovial Bursæ.

A description of the pathological affections to which the synovial bursæ are liable will be found in the essay on AFFECTIONS OF THE MUSCULAR SYSTEM, to which the reader is referred. The situation of the subcutaneous bursæ, at least of those which are most liable to disease, is well known, and they are at once so accessible to examination, and the symptoms attendant on their morbid conditions so characteristic, that mistakes concerning them are hardly likely to arise. In the case of the deep-seated bursæ, however, this is by no means so certain. Their diseases simulate to a much greater extent disease of the neighboring joints, and, indeed, frequently lead directly to it; for in many instances these bursæ are continuous, or have some connection with the articular synovial membranes, so that direct extension of inflammation may occur from one to the other. In the description, therefore, of the special characters which attach to the diseases of the individual joints, I shall have occasion again to refer to the deep-seated bursæ, and to the means of distinguishing their affections from those of the articulations.

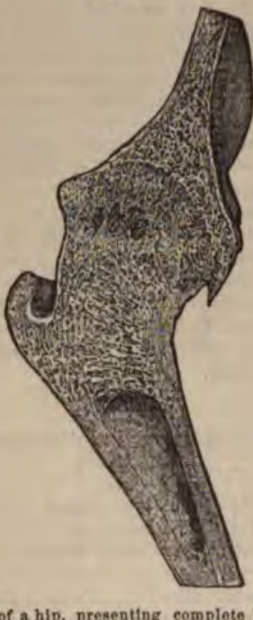
Altered conditions of the Integuments around the Joints.

The diarthrodial joints are intended to allow of free movements of the bones which enter into their composition. If these movements are interfered with, the joint is truly affected, whether the seat of the obstruction is in one of the proper articular structures, or has only an indirect connection with them. Whenever the integuments have been extensively destroyed around a joint, the resulting cicatrix, and the accompanying induration of the subcutaneous areolar tissue, may cause the articulation to be partially or almost wholly rigid. The cases in which this usually occurs are those resulting from extensive burns; and here too we often find a limb rendered useless, and hideous deformity produced, by the original extent of the injury, or by the want of proper forethought during the healing process. In the essays on BURNS and on PLASTIC SURGERY, the importance of considering the position to be chosen for the limb, when the burn has invaded the circumference of an articulation, has been pointed out, as well as the best means to be adopted for preventing injurious contraction at the time, or for remedying it if it has unfortunately occurred. I have thought it right, however, not entirely to omit in this essay any allusion to the fact that a natural condition of the surrounding integuments is of importance to the integrity of the joint.

ANKYLOSIS.

A want of precision occasionally attaches to the sense in which the term ankylosis is used. Originally, as the word itself implies, it was applied solely to joints which had become fixed in an *angular* or bent position; rigidity when the limb was straight receiving another designation (ὀρθόκωλον). The position which the limb has assumed is no longer specially designated, but we speak at the present day, somewhat clumsily it is true, of ankylosis as being *true* or *false*; the latter, at any rate, having a somewhat vague signification in the minds of many authors. By *true ankylosis* (*synostosis*) is meant actual osseous union of the contiguous bones. This implies, in most cases, destruction of the entire joint, and constitutes a further or final stage of the process of junction by fibrous tissue, which has been described in previous sections, and which forms one variety of false ankylosis. A form of osseous ankylosis, moreover, is sometimes met with in which the new bone is placed *outside* the articulation. This variety is most common in the spine, which occasionally presents superficial bridge-like bony processes extending from one vertebra to another, or even forming a kind of osseous sheath enclosing several vertebræ.

Fig. 669.



Section of a hip, presenting complete bony ankylosis of the ilium and femur. (From a preparation in the Museum of St. George's Hospital.)

False ankylosis may be *intra-capsular*, when it signifies a junction of the articular surfaces of the contiguous bones by a comparatively soft or membranous tissue (the joint-cavity being partially or completely destroyed), or it may be *extra-capsular*, the union of the bones in this case depending on adhesions around the articulation, with thickening and induration of the capsular or ligamentous tissues in that situation. The latter, or extra-capsular false ankylosis, usually accompanies the former; but it may exist alone, as was seen in a case related by M. Bonnet, where the articulation was completely fixed even when section of all the muscles around had been performed after death, whilst the interior of the joint was found to be perfectly healthy, the ankylosis resulting from the presence of an enormous mass of fibrous tissue in the ham, uniting the femur to the tibia.[1] Impaired mobility of the joints may result, no doubt, from other causes. In chronic osteo-arthritis, for instance, the shape of the articular surfaces is altered, or bony vegetations are formed around them, which mechanically impede or arrest motion. The joint may be crippled by the contraction of cicatrices after injuries or diseases affecting the integuments and contiguous tissues. Muscular retraction, too (so often present in and complicating ankylosis), may alone interfere with freedom of movement. These cases, however, may be termed "articular rigidity," rather than ankylosis.

Ankylosis is occasionally seen in advanced life affecting some of the minor joints without the existence of much obvious cause to account for its presence. As a rule, however, ankylosis, whether true or false, results from inflammation, common or specific, which has affected a joint, and produced a certain amount of destruction of the parts, followed subsequently by reparative action. In the majority of joints there is little difficulty in determining the fact that motion is at least impaired, if not altogether lost. In the hip and shoulder, however, it is necessary to be careful that increased mobility of the pelvis (especially noticed in children) or of the scapula is not mistaken for action of the articulation. The determination of the exact cause of the rigidity is not always easy. In chronic osteo-arthritis, irregular osseous processes may, perhaps, be felt, and the character of the deformity will assist in the diagnosis. When retraction of the muscles is the sole or principal cause of the impaired mobility, the tendons may be felt rigid beneath the skin. If the areolar tissue around the entire joint or at one part of it is indurated, inextensible, and traversed by sinuses, we may suspect that the extra-capsular form of false ankylosis is not entirely absent. If some degree of motion, however slight, can be given to the joint, we *know* that true or osseous ankylosis is not present; although the converse of this is not equally certain, for in false ankylosis the firmness of union may be so great as to render it difficult to detect any motion, even when muscular opposition is removed by means of chloroform [or ether].

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[1] Bonnet, Sur les Maladies des Articulations, tome i., p. 130.

Treatment.—It has been already explained that a time may come in the progress of articular disease when it is necessary to exercise the joint; when passive motion must be had recourse to, and friction in its various forms assiduously employed. These measures constitute what may be termed the preventive treatment of ankylosis. Supposing that they have not been adopted, or have been inadmissible, and ankylosis has actually taken place, the treatment will depend greatly on the position in which the limb has become, or is becoming, rigid. If the position is suitable, in true ankylosis (synostosis), so slight an amount of further improvement can be hoped for, that no interference will probably be attempted. In false or fibrous ankylosis, on the other hand, if the case is seen at a sufficiently early period, the general plan of what was termed preventive treatment may usually be employed with safety to prevent soft union from becoming osseous, and also to increase such mobility as may be present, by stretching the soft uniting structures, and so adding to the usefulness of the limb.

Unfortunately it too often happens, from ignorance or carelessness on the part of the patient or his friends, possibly even in a very few cases, from remissness on the part of the surgeon in not sufficiently guarding against malposition in joint-disease, or from his hesitating to correct it at its commencement, when simply dependent on muscular spasm, that the joint may have become ankylosed in the original sense of the word, or at least in a *faulty* position, for the same position is not of equal use in all articulations, or even in all classes of persons; in certain trades, for instance, a special position is often desirable. Early treatment, then, is necessary, if the limb is to be rendered serviceable, instead of becoming simply an incumbrance. Supposing the case to be one of false ankylosis, the first thing to be done is, to place the limb in that position in which it may be employed to the greatest advantage, and subsequently, when inflammation has subsided, to increase the mobility of the joint, if any increase is considered possible. The means at our disposal for the purpose of relieving the deformity have been augmented by modern discoveries: by the employment of chloroform we annihilate pain, and get rid of the active muscular contraction which would greatly impede our efforts; and by means of subcutaneous surgery we are furnished with a safe and ready method of overcoming the passive or permanently rigid state into which some of the muscles are likely to have fallen; a state which adds materially to the resistance offered by the joint.

The replacement may be immediate or gradual. In a large number of cases, where the required amount of alteration is not very considerable, the immediate process is preferable, the chance of mischief arising in consequence of the sudden change from a position which may have lasted for a length of time, not being very great if the operation is properly performed, and the after-treatment careful and judicious. In many instances, however, the restoration of shape can be better effected gradually or painlessly by simple mechanical contrivances carefully adapted to the individual joint, and in such cases this plan of treatment may properly be adopted. (See the essay on ORTHOPÆDIC SURGERY.) If immediate reduction is determined on, it is desirable that the surgeon should have a clear notion of what he is about to do; that he should have determined the position to be chosen, and calculated the obstacles to be overcome. The key to success in the process of immediate replacement consists in the previous manipulation. When the patient is placed under chloroform, therefore, the movements for the purpose of breaking down the adhesions which have formed should be properly adapted to fulfil their purpose. Instead of applying the force employed simply in one direction, by attempting *at once* to straighten the limb, the first process is to move the joint in every sense so as to render it as supple as possible. Accordingly the limb is to be alternately flexed and extended (or, it may be, abducted and adducted likewise) steadily and gradually with somewhat increasing force, till as much as possible of the natural extent of motion is obtained. When the adhesions are sufficiently broken down, the limb may then be placed, by appropriate traction and pressure, in a proper position, and secured on a splint.

Many cases of ankylosis, it was stated, are complicated by the existence of muscular retraction, which prevents the necessary movements for the relief of the ankylosis. If the existence of this retraction is evident, the muscles may be divided subcutaneously a few days before the main operation. It may happen, however, that a retracted condition of one or more muscles only becomes evident during the manipulation under chloroform. One of two courses may then be adopted. Having restored as much motion as possible to the joint, tenotomy may be practised on the opposing muscles, and the remainder of the operation suspended till the wounds have entirely healed. Or, as M. Bonnet recommends, after subcutaneous section has been practised, the movements may be persevered in till restoration of the articular functions is effected to the greatest practicable extent. If the latter plan is adopted, a very long but fine tenotomy-knife should be employed, and the integuments punctured at a considerable distance from the point of section of the muscle, to avoid if possible the risk attendant on the admission of air to the cut surface during the movements which are being performed.

As the effects of chloroform pass off, the pain which is experienced may be expected to be severe for some hours, but speedily subsides, without the development, usually, of any very severe inflammatory symptoms. Constant irrigation of the joint may be practised for the first day or two in the manner described in a preceding section, the limb being effectually secured on an open splint (the plan I usually adopted at the Hospital for Sick Children); or the whole limb may be wrapped in cotton wool, and the bandage at once starched, as recommended by Bonnet. When the proper direction has been restored to the ankylosed limb, and any inflammatory symptoms produced by the force employed have subsided, it is time, if the case is one which allows of any hope of success, to adopt such measures as may tend to develop renewed mobility of the joints. For this purpose, baths and friction may be employed, and steady and judicious passive motion had recourse to, which may be performed by the hand (usually sufficient in the child); or still better, in the adult, by various mechanical contrivances, which could hardly be understood from any verbal description.

In estimating the chances of success from these proceedings, the age of the patient and the duration of the lesion are mainly to be considered. In youth, and especially in childhood, at an age, that is, under sixteen, assuming the constitutional condition to be good, the results are usually favorable. In middle life, there is still a fair hope of success, or at least of much improvement. Beyond this period, however, and as advanced age is attained, the chances are much diminished; and if the lesion is of old standing, if the adhesions have acquired great solidity, or if the ankylosis is complicated with other local mischief, not much hope of benefit can fairly be entertained.

When the ankylosis is *osseous*, the means already spoken of are obviously inapplicable. Supposing the position in which the ankylosis has occurred to be inconvenient, it has been proposed by Dr. Barton, of Philadelphia, to remove a wedge-shaped portion of the bone from the projecting surface of the angle formed by the limb; the extent of the broad part of the wedge varying, of course, with the amount of the deformity. When this osseous wedge has been removed, either from the ankylosed part itself, or a little above or below this point, as may be considered expedient, the remaining thickness of the bone is fractured, and the two surfaces brought together so as to redress the angular deformity previously existing.[1]

Finally, cases of ankylosis are sometimes met with in which the limb is not merely useless, but an incumbrance, whilst the continuance of disease in the bones, or the existence of other complications affecting the surrounding structures, prevents replacement from being effected. It may then become expedient to remove the diseased joint, or even the entire limb. The propriety of such operations must obviously depend upon the merits or peculiarities of each individual case.

[Forcible motion is useful not only in joints absolutely stiff from fibrous adhesions, but also where some motion is possible, limited by single or partial adhesions. For the recognition of partial adhesions, according to Wharton Hood, two indications are sufficient, viz., a slight degree of mobility checked by pain, and accompanied by a spot tender on pressure. In such cases a quick forcible movement sufficient to rupture the adhesions is beneficial, while insufficient attempts at forcible movements are injurious, exciting irritation, without removing the source of the pain. The method used by Mr. Hutton, one of the most celebrated of "bone setters," was, according to Mr. Hood, as follows: After thorough examination to determine that no active inflammation was present, a spot tender on pressure, usually on the inner side of the joint, was found. The limb was seized, pressure made upon the tender spot with the thumb of one hand, and the limb forcibly flexed, or flexed and extended, abducted and adducted. The direction of movement should depend upon the direction of resistance. Pulling the limb is of little use in breaking up these adhesions, according to Mr. Hutton, but a rotation or twist appeared to be of service.

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[1] See also the essay on ORTHOPÆDIC SURGERY, in this volume, for an account of a less severe form of operation recently introduced by Professor Gross.

The affections in which these manipulations are of use, are in joints stiff after a sprain, or after immobilization in fractures near a joint, joints affected by the results of too long continued rest, or the adhesions of periarticular inflammation, or hysterical joints.[1]

Koch reported before the seventh Congress of German Surgeons a hyperæsthesia of the joints, characterized by great pain on moving the joints, but without anatomical lesion in the articulations. This he showed by experiments follows certain injuries to the spinal cord, which may develop not only a hyperæsthesia of the skin, but also of the fasciæ, periosteum, and joints. This followed also injury involving the lateral cerebellar cords, but not injuries to the great nerve-trunks.

In these cases powerful electrical irritation of the skin relieved the pain, but did not effect a cure. Narcotics were of no use.[2]]

ARTICULAR NEURALGIA.

We frequently meet with cases where pains are experienced in the joints without any appreciable material lesion to account for them. In many instances these are termed, and no doubt correctly, rheumatic or gouty pains, for these two conditions may have manifested themselves unquestionably in other articulations, or may ultimately appear in those which have been the seat of the erratic suffering. Occasionally pain gives a brief warning of mischief about to be developed, which it precedes only by a short time. In the pyæmic condition, for instance, a sharp pain may be felt in some joint, and though no other sign of diseased action is present, we are led to expect the formation of matter in this situation, and the progress of events commonly justifies our apprehensions.

The pain may have a local origin, independent of any disturbance in the joint in which it is experienced. The pressure of a tumor on some nervous trunk may give rise to suffering referred to its articular branches; and all surgeons are familiar with the fact, that pain in the knee is one symptom of disease within the hip, and yet this sympathetic affection may so mask the original disease, that I have frequently had children with diseased hip brought to me, in whom blisters or other local remedies had been applied to the knee, under the idea that *it* was the seat of mischief.

Unquestionably, however, the majority of these cases are dependent on that abnormal condition of the nervous functions which is termed hysterical. The condition, indeed, is not absolutely confined to the female sex, as the original signification of the term would imply (ὑστέρα, womb), for it may occasionally be met with in males, though far less frequently than in the other sex. When this morbid condition of the nervous system prevails, a local direction is often given to the perverted sensibility, by some accidental concentration of the "*attention*" on the part. The physiological effects of undue "attention" on organs are of great interest, and serve to explain many curious phenomena exhibited in certain disturbed conditions of the nerve-centres, which may be induced artificially, as in hypnotism, or arise from less obvious internal causes, as in hypochondriasis. I am unable in this essay to devote more space to this subject, but must confine myself to a simple notice of the effects which may be produced by involuntary or automatic "attention." A woman is brought into close relation with some one suffering from cancer of the breast; the attention is directed involuntarily to the corresponding organ in herself; the part becomes painful, swelling even occurs, and what is termed neuralgia of the breast is set up. A case is related of a gentleman who lost

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[[1] Bone Setting. Wharton Hood, London, McMillan & Co., 1871; Med. Times and Gaz., April 17, 1880.]

[[2] London Med. Record, May 15, 1878, p. 222; see also Shaffer, The Hysterical Element in Orthopædic Surgery, New York, Putnam, 1880; Jacobi, Am. Journal Obstetrics, June, 1876, p. 218; Paget, Nervous Mimicry, Lancet, Nov. 11, 1873, p. 619; Neurosis of Joints, Berl. Klin. Woch., 1874, No. 26.]

an intimate friend from cancer of the œsophagus: the sufferings which he witnessed made a strong impression upon his mind; he began himself to experience difficulty of swallowing, and ultimately died from the effects of spasmodic dysphagia.

In hysteria, when the attention has been fixed on an articulation from mental or from emotional causes, or in consequence of some slight injury, symptoms which might be supposed to indicate structural disease of the joint are apt to show themselves. There is great *pain;* pain out of proportion to the other symptoms, and frequently extending over a large surface, but often suspended if the attention is diverted, and completely absent during sleep, which may be prolonged and sound. The *tenderness* is also exaggerated, and usually greater in the integuments than in the deeper structures; it is little felt, too, on firm pressure on the articular surfaces effected from a distance. There is sometimes a slight amount of *swelling*, which is diffused in the external areolar tissue, and arises from a turgid condition of the small vessels, or from increased effusion into the areolar interspaces. On handling the part, *fine crepitation* is often felt, evidently situated near the surface, and differing essentially from the grating or crackling which may be attendant on removal of the cartilages. Frequently *convulsive* or *spasmodic action of the muscles* is induced by any attempt to bend or straighten the joint; or sometimes there is a more permanent *rigidity*, by which the limb is fixed in some improper position. When volition is suspended, however, the rigidity and the spasm are suspended likewise. General symptoms indicating hysteria are often present; in many cases there is habitual coldness of the extremities, with other evidence of weak circulation; but articular neuralgia is sometimes seen in stout and florid girls. Some irregularity of the menstrual functions is usually present.

The diagnosis in these cases is generally not difficult, for it is commonly easy to detect symptoms which unequivocally vary from those which would be induced by true structural disease. It may be mentioned, however, that in old cases the patient may have acquired so much information regarding the symptoms which ought to be present, that less chance is afforded to the surgeon of detecting any palpable inconsistency. Where any doubt exists as to the true character of the affection, time should be taken before a positive opinion is pronounced; a careful examination, too, should be made, to detect and remove any local cause of nervous irritation; for these sympathetic pains may be maintained by disturbance of parts with which there is indirect nervous communication, and relief of the one will be followed by cessation of the other.

The general principles of the treatment have been laid down in the essay on HYSTERIA. In most cases tonics and antispasmodics are beneficial. Great attention should be paid to the due action of the skin and liver; and where a tendency to periodicity is present, quinine is of marked service. Change of air and occupation are beneficial, especially residence at the seaside, where salt-water bathing, general or local, can be easily enjoyed. The patient should be urged and encouraged to use the articulation. If the limb is contracted, and any attempt at restoring the joint to its natural position is strongly resisted, chloroform may be had recourse to, and the part maintained afterwards for a *short* time on a splint, with advantage; but exercise of the joint should speedily be enforced. The moral treatment to be adopted is of material importance. The attention of the patient must especially be directed elsewhere, every effort should be made to cultivate the power of "self-control," and healthy occupation given, if possible, to the mental as well as to the bodily functions. A judicious mixture of firmness with kindness must also be exhibited both by friends and surgeon, and the confidence of the patient acquired, which can never be done if any form of deception is had recourse to, as has sometimes been recommended.

INJURIES OF THE JOINTS.

Wounds of Joints.

The joints are liable to various and severe injuries. The ligaments and other soft parts in the neighborhood may be strained or otherwise damaged; the bones may be suddenly forced apart, and their natural relation to each other altered; or a fracture may extend into and implicate an articulation. These injuries, however, have already been described, generally, under the heads of DISLOCATION and FRACTURE, or, as they affect the individual joints, in the essays which treat of injuries in the different regions. The subject of *wounds of the articulations* is the only one that remains, therefore, to be noticed in this place.

In treating of wounds of the joints, I shall confine myself to those in which the synovial membrane is actually penetrated, indicated by the presence in the blood of thin lines or streams of semi-transparent glairy synovia. The wounds may be punctured, incised, or contused. The gravity of a *punctured* wound is influenced to a certain extent by the course which it takes, as well as by the nature of the instrument with which it is inflicted. When oblique in its direction, of narrow dimensions, and made with a sharp clean weapon, it corresponds to the wounds produced in subcutaneous surgery, and has comparatively little tendency to give rise to suppuration; a direct wound, on the other hand, even of the same size, is more prone to produce serious mischief, especially if it is made with a blunt or jagged instrument. To a certain extent, the same observations apply to *incised* wounds, but their greater dimensions much increase the chance of the admission of air, and of the supervention of destructive inflammation, whatever the direction they have taken. *Contused* wounds of a joint may be inflicted from within or from without. The former have been described under the head of Compound Dislocation; the latter are produced by heavy or blunt instruments, and are formidable from the injury of the soft parts they involve, and the consequent chance of mortification, as well as from the inflammation they may be expected to induce.

Under favorable circumstances, the edges of an incised or punctured wound, if maintained in perfect apposition, may unite speedily by the processes described in the essay on WOUNDS, and the articulation be restored to a sound and healthy condition. When the wound is much contused, the edges gaping, or when other circumstances are not favorable, severe inflammation takes place, suppuration rapidly ensues, and destruction of the joint may be expected to occur. The mischief may not even be confined to the articulation; pyæmia may be established; or the patient may sink, exhausted by the profuse discharge, and the fever excited by the local irritation; there is also a risk of tetanus making its appearance.

The causes of the grave character of these lesions are not, perhaps, difficult of comprehension. When early union does not take place, and repair has to be effected by what is called the "second intention," suppuration occurs; but the matter is formed not merely at the divided surfaces, as in ordinary wounds, but extends to, and accumulates in, a large and often intricate synovial cavity, which does not communicate freely with the surface, but allows of burrowing and confinement of the pus, and so favors its decomposition, with the consequent constitutional disturbances. The structure of some of the tissues which form the walls of the cavity is also most unfavorable when suppuration has occurred; instead of being vascular and full of life, soft and able to approximate and contract, the cartilaginous surfaces in the joints are unyielding, and so low in their vitality as to be little capable of efforts at reparative action; even when the cartilages disappear, the osseous structures which are exposed are themselves far less adapted for the process of granulation than the softer tissues, and obliteration of the pus-forming cavity becomes a slow and tedious process, often interrupted by local or constitutional mishaps. Finally, even if repair does not take place, it has been effected at the expense of the functions of the part; for union of the opposing surfaces of an articulation involves ankylosis, and consequent loss of mobility—the purpose for which the joint was constructed.

When a wound exists in the neighborhood of an articulation, it may be of such a size, and have so freely exposed the interior of the joint, that no doubt can exist as to its extent. In certain cases, however, it is not always easy to determine whether the synovial membrane has been injured or has remained intact. We are guided in our opinion by the position of the wound, its direction, the degree of penetration, and the form of the weapon. Our diagnosis may be assisted by the presence in the flowing blood of semi-transparent glairy synovia in thin lines or streams; but the absence of synovia does not prove that the articulation is uninjured (for its escape may be prevented by various circumstances), and its presence is not conclusive in favor of injury, for the fluid may have been discharged from a synovial bursa or from a tendinous sheath. When any doubt exists, researches with a probe had better be avoided, and the case treated at first as if penetration had undoubtedly occurred.

The dangers attendant on a wound extending into an articulation are influenced by several circumstances. In early life such wounds are usually attended with less severity of symptoms than at a more advanced age, and a good constitution is more likely to do well than one which has been broken down by prolonged debauchery. A small joint will escape with impunity where a large one would be destroyed; and even if the articulation is destroyed, the general disturbance may be trifling. The upper extremity is more favorably situated than the lower, as far as the chance of recovery is concerned; and finally, a wound inflicted with a sharp instrument is more likely to unite than one which has been attended with much violence to the softer tissues.

In managing a wound of a joint, it becomes evidently of the highest importance to procure, if possible, immediate union, and prevent the occurrence or check the spread of inflammation. Every wound involves a tendency to inflammatory action; but the smaller the amount which is excited, and the more complete the absence of inflammatory exudation, the better the form of healing which occurs. The size of the wound, and the degree of violence with which it was inflicted, are elements in the production of inflammation over which we have no control; a third element is the duration or amount of exposure to the atmosphere; this is within our reach, and the importance which has long been attached to the prevention of access of air to a wounded joint is fully justified on theoretical as well as on practical grounds.

When there has been much laceration and contusion of the soft parts, little or no chance of immediate union exists. For the description of the management of this class of wounds, however, the reader may conveniently be referred to the essays which treat of Gunshot Wounds and of Compound Dislocations; for contused wounds of joints usually fall within one or other of these two categories. In punctured or incised wounds, if seen at a sufficiently early period, the treatment is directed to procure rapid union, and prevent the occurrence of inflammation, or reduce it to a minimum. For this purpose, we retain the wounded surfaces in close apposition, and adopt such measures as will ensure perfect immobility of the joint, whilst we exclude all exposure to the air. If any foreign or detached body is present—a piece of glass, for instance—it is carefully removed, and the wound, having been gently cleaned and thoroughly washed with a solution of carbolic acid, must then be closed effectually and its surfaces, for their entire depth, kept in close and steady apposition. [A description of the treatment of wounds of the joints, according to antiseptic principles, belongs properly to the subject of Antiseptic Surgery. It may be mentioned, however, that in case of direct opening into a joint, it is essential to secure, first, good drainage for such fluid as may accumulate; and, second, to prevent putrefaction of the discharges by syringing out the cavity with antiseptic fluid, and the application of an antiseptic dressing.] The mode of effecting this must vary; where only a small puncture exists, it may be sufficient to apply a piece of lint, which may be soaked in carbolic oil or blood, or covered with collodion; if the wound is of some extent, something more is required; on the whole, sutures are preferable to adhesive plasters, being less liable to be disturbed, and admitting of the application of moisture to the part; the twisted suture appears to be the most efficient, as it maintains the divided surfaces in contact to a considerable depth. The wound may then be protected from the air by a covering of stout tin-foil, previously washed with the solution of carbolic acid, and nicely adapted to the surface, this being again covered by a rather larger piece of lac plaster charged with carbolic acid, and a fold of lint dipped in carbolized oil (as described by Mr. Lister) applied over the plaster and renewed, by being moistened with the oil, once at least in twenty-four hours; the under-dressings, of course, not being interfered with unless it becomes absolutely necessary to do so. The limb must be carefully secured on a splint, or otherwise fixed in that position which will be most advantageous to the patient should rigidity ultimately occur. As perfect immobility is of the greatest importance, the splint must be carefully selected, so as effectually to prevent any articular movement. The immediate and continued application of cold to the part, in the form of irrigation or of iced water in vulcanized India-rubber bags, is usually attended with great advantage in preventing or subduing inflammation. The general treatment, at an early period, should be moderately antiphlogistic, without permanently lowering the strength, great demands on which may be expected should events take an unfavorable direction. Care should be taken not to disturb the antiseptic dressings so as to allow the wound to be unprotected by them, and the sutures may be left with advantage for many days, perhaps a week, or so long as there is any hope of union being obtained, unless their removal is required to give exit to matter.

In spite of the measures adopted, or in consequence of the case coming too late under treatment, inflammation may run high and suppuration occur. When matter has unquestionably formed, any attempt at union is abandoned, and free exit afforded to the pus, either by enlarging the original wound, or, if necessary, by making free incisions in a more depending position; but an attempt may still be made to arrest decomposition of the matter by the continued use of antiseptic dressings. The further progress of the case does not differ materially from that already described under the head of Suppuration in Joints (see p. 242), to which the reader is consequently referred.

[As is well known, dangerous symptoms frequently follow punctured wounds of the joints, but cases are sometimes met where wounds of this character heal without trouble. This is not only true of large openings made by cuts through the ligamentum patellæ with an axe or scythe, but also of small penetrating wounds.[1]

[[1] See Alfred Hosmer, Boston Medical and Surgical Journal, April 17, 1879. Six cases

How frequently evil results from wounds to the joints follow, and when immunity from surgical fever is to be expected, it is impossible to say.

Pirogoff saw in the Crimean war only three recoveries from shot wounds of the joints after suppuration had occurred.

Bergmann, in the late Turko-Russian war, out of fifty-nine wounds of the knee-joint saved thirty under a non-antiseptic treatment. Amputation was, however, necessary in two of them.

The results of injuries to the large joints during the war of the Rebellion have not been as yet published. Out of seventy-two cases of gunshot wounds penetrating the shoulder-joint, without osseous lesion, six died (two from pyæmia), thirty-six recovered with stiff joints, thirty were returned to duty. (Surgical History of the War of the Rebellion, Part II., Surgical Volume, p. 502.)

Pirogoff, however, met with five recoveries from incised wounds of joints without suppuration[1].

For exact rules of treatment in joint diseases we must wait until exact diagnoses of the pathological changes can be made. It is manifest that a chronic synovitis, a tuberculous epiphyseal osteitis, and a peri-articular inflammation should be treated at their earlier stages on different principles. The indications for treatment vary also in the different joints according to their anatomical relations, whether surrounded by powerful muscles or superficial; whether needed in locomotion or not. Certain facts, however, are self-evident: if severe pain is caused by jarring a diseased joint, it should be protected from jar; the patient's general condition needs in a chronic affection lasting through years all influences for improving his health, of which the most important is exercise; motion increasing a synovial inflammation should be avoided, as well as a long disuse of a part whose normal condition is use. Reflex muscular contraction is an indication requiring in certain joints, for the future usefulness of the limb, almost as careful treatment as the original lesion. It has been a practice to treat all diseases of joints as fractures would be treated; *i. e.*, by complete fixation until the limb is well, forgetting that a fracture necessitating immobilization for a year would secondarily cause nearly as much uselessness resulting from treatment as that made by the original break.

Verneuil recently expressed his opinion that absolute rest in itself never gives rise to false ankylosis, and that the stiffness following fixation is not the result of changes in the joint caused by the want of motion, but of inflammation checked eventually by rest, but not until certain changes in the peri-articular tissues were brought about. Whether firm adhesions ever follow complete fixation or not may be a question; but it is certain that stiffness takes place, and the period comes when motion is essential to the health of the joint. The problem of the treatment of chronic joint-disease consists in allowing protected motion when the activity of the arthritic inflammation does not demand absolute fixation.

The benefit derived from extension in certain joint affections has been variously explained. It has been regarded as a means of, 1, separating the diseased bones of a joint; 2, of overcoming the spasm of the muscles around the joint; 3, of fixing a joint.

In certain articulations extension certainly separates the bones, as in the finger-joints; in others, as the hip, the bones are not separated by any force which can practically be applied if the capsule is in a normal condition.

Schultze found that the immediate effect of extension on a joint, both knee and hip, filled with fluid, was an increase in the interarticular pressure. After extension was prolonged for a while (seven or eight days) there was a diminution, due either to the relaxation of the ligaments, or to an absorption of the fluid from an increase of the interarticular pressure.[1]]

PART II.

DISEASES OF INDIVIDUAL JOINTS.

The limited space at my disposal requires that any observations I have to offer respecting the peculiarities presented

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of wounds of the Knee-Joints. For results of antiseptic treatment of Wounds of Joints, see Cheyne, Brit. Med. Journal, Nov. 29, 1880. Eleven cases Wounds of Joints successfully treated, and twenty-one cases of successful operation on Healthy Joints; Wolberg, Berl. Klin. Wochenschr., No. 47, Nov. 22, 1880, p. 668.]

[[1] Wolberg, loc. cit.]

[[1] Deutsche Archiv f. Chir., 1877, vii., p. 76; Reyher, Ibid., 1873, No. iv., p. 26; Ranke, Centralb. f. Chir., 1875, p. 609; Morosoff, Archives générales de Médecine, 1878, p. 718; also Boston Medical and Surgical Journal, Nov. 11, 1880; Chicago Med. Journ., Jan., 1878; Stillman, New apparatus for extension, London Med. Rec., Oct. 15, 1880, p. 395.]

by disease as it affects individual joints should be extremely brief.

Diseases of the Hip.

Lesions of the hip have attracted especial attention from the importance of the articulation involved, the depth at which it is situated, the mass of soft parts which surround it, and the little leverage afforded by its upper attachment in the pelvis. At the same time, unfortunately, disease of this joint is met with only too frequently, and constitutes one of the most troublesome lesions to which the human frame is liable.

As in other joints, the structures in which disease for the most part commences are the synovial membrane and ligaments and the articular extremities of the bones. Mr. Aston Key was of opinion, from the amount of mischief which is sometimes found in the ligamentum teres at an early period of the disease, that this was the part in which inflammation usually commences. At any rate, there is reason to believe that the ligaments (including the capsule) are often among the earliest structures to be affected.

Acute arthritis of the hip, whether occurring primarily, or in the course of chronic disease, is very serious and often fatal. The symptoms are usually unmistakable, and if matter forms, as is often the case, it should be evacuated early, and antiseptics freely used. The expediency of amputation or excision must be judged of by the circumstances attendant on each individual case.

Common synovitis, as a primary affection, is less frequent in the hip than in the superficial joints; though when it occurs, its symptoms are usually severe, and the suffering experienced considerable.

Morbus coxarius; strumous synovitis and ostitis.—The disease of the hip which is most common, and which is so often met with in early life, is chronic or strumous inflammation, sometimes commencing in the synovial membrane or ligaments, but frequently, also, in the articular extremities of the bones. In retaining the term *strumous*, however, we must bear in mind that, as already stated, it by no means follows necessarily that there is a special tendency to tubercular deposit in the joint or in any other part of the body, or that such general cachexia exists as will prevent reparation of the local mischief. If attention to the general health is *desirable*, attention to the local treatment (especially in the form of securing the joint in a most perfect state of rest), is *indispensable*, and any neglect of it on the part of the surgeon hardly admits of excuse.

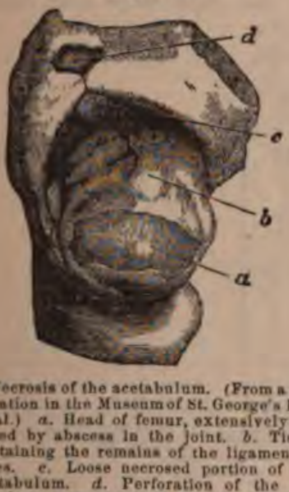
It is of great importance to recognize chronic hip-disease as early as possible, before permanent mischief has occurred. The first symptoms to be noticed are, a slight limp in walking, with disinclination to bear the whole weight of the body on one particular limb; if attention is now carefully drawn to the patient, the thigh will probably be found to be slightly flexed on the abdomen, and a certain amount of feverishness may be noticed towards evening, after a day's exercise, with a little restlessness during the night, accompanied, perhaps, with slight occasional twitches or jumps of the thigh, which will usually be somewhat flexed and adducted during sleep. If a careful examination of the hip is now made, it will be found to be held a little stiff, and some pain will be evinced on moving the joint or on pressing the articular surfaces together, either directly at the greater trochanter or front of the joint, or indirectly through the foot.

If these symptoms are not attended to, and the disease proceeds a stage further, the lameness becomes very marked, the limb will be found apparently altered in length, flattening of the nates will be detected on examination, and very decided pain will be complained of. The causes of the apparent alteration in length are mechanical. The thigh is flexed on the pelvis, but combined with this flexion, which is very seldom *simple*, are two principal deviations; in the one case we find inclination and rotation *outwards*, attended with apparent elongation of the limb; in the other, there are inclination and rotation *inwards*, producing apparent shortening. Now, supposing the femur to be bent at an angle on the pelvis, and the foot turned out, when the patient tries to stand or walk the weight of the limb has to be supported, but in order that the foot may reach the ground, that side of the pelvis is depressed and advanced in front of the other; in this way the limb *appears* to be elongated. In the opposite condition of flexion combined with adduction and rotation inwards, the corresponding side of the pelvis, for a similar reason, is raised and carried backwards; a position which involves apparent shortening when an attempt is made to place the limbs parallel with one another. The position which is recommended as best suited for examination is that in which the trunk and the *sound* limb are perfectly straight: the nature of the alteration, as it affects the diseased side, is then more evident than if the two thighs are placed parallel.

The fixed and altered direction of the affected extremity soon entails secondary deformity in other parts, especially in the spine. When the thigh is fixed at an angle with the pelvis, in order that the weight of the extremity may be supported, the pelvis itself becomes inclined forwards; to compensate for this inclination and maintain the balance of the body, the vertebral column is strongly curved, producing a deep hollow in the lumbar region, with corresponding projection of the abdomen anteriorly. The exact nature of this secondary deformity is readily seen, either in the recumbent or in the erect posture, on supporting the affected limb at the angle which it has assumed, when the pelvis and spine may easily be restored to their natural direction. Lateral deviation of the spine may also be induced, to compensate for the lateral inclination or twisting of the pelvis. The pelvis, it will be noticed, shifts or alters its position; and, indeed, increased mobility of the pelvic articulations often occurs to an extraordinary extent, especially in the later stages of hip-disease, when recovery is taking place, with ankylosis or rigidity of the hip itself. In such cases, in early life, the amount of motion which becomes developed at the sacro-iliac synchondrosis and other neighboring joints may closely imitate the natural mobility of the hip, and easily deceive a careless observer.

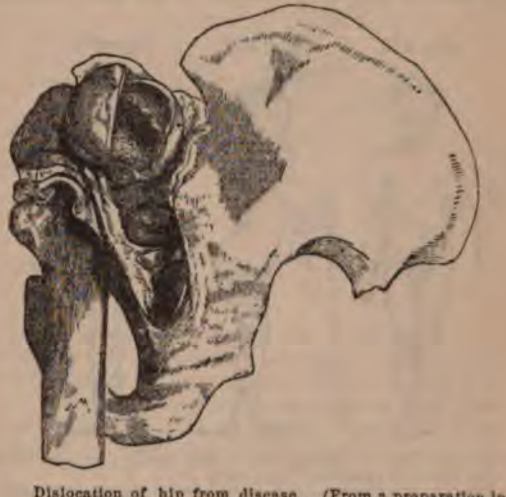
The condition of apparent shortening frequently follows that of apparent lengthening, though it may occur where no lengthening has ever manifested itself. Is there ever any *real* alteration in length? Though many causes have been advanced which might give rise to actual elongation of the limb, it is hardly probable that any of these should actually occur, and it may be said that the lengthening is, in truth, only apparent, depending on the altered position of the pelvis. In the early stages of hip-disease the same observation holds good with respect to the opposite condition. In other cases, however, a certain amount of genuine shortening really does take place. When the osseous structures are involved in the disease, the spasmodic contraction of the muscles maintains constant pressure of the head of the femur on the upper part of the acetabulum; if this is already softened, and the cartilages ulcerated or absorbed, the border or edge of the acetabulum yields to the pressure, it becomes deeply ulcerated and excavated, and the head of the femur itself, which has been more or less disintegrated, is drawn up into this excavation, which is enlarged to receive it, in the direction of the external iliac fossa. This condition constitutes what has been termed *spontaneous dislocation* from disease, which differs evidently from traumatic dislocation, in which the head of the femur clears the rim of the acetabulum, which remains intact. When this false or incomplete luxation has occurred, the trochanter major will be found to be displaced upwards, and a certain amount of real diminution in the length of the limb will be present, increased, of course, if the head of the femur is destroyed to any extent. In some cases, however, *true* luxation from disease actually occurs, as may be seen in the accompanying illustration, taken from a preparation in the Museum of St. George's Hospital, in which the head of the femur is situated very near the ante-

Fig. 670.



Necrosis of the acetabulum. (From a preparation in the Museum of St. George's Hospital.) *a*. Head of femur, extensively exposed by abscess in the joint. *b*. Tissue containing the remains of the ligamentum teres. *c*. Loose necrosed portion of the acetabulum. *d*. Perforation of the acetabulum corresponding to the necrosed portion.

Fig. 671.



Dislocation of hip from disease. (From a preparation in the Museum of St. George's Hospital.)

rior superior spine of the ilium. In very exceptional cases, too, the head of the femur is forced through the acetabulum, so as to enter the pelvic cavity.

Another, and a very striking change, which will be found at a comparatively early period, consists in a certain amount of alteration in the fulness of the nates. These are often flattened and appear wider than natural. This alteration depends partly on wasting of the gluteal muscles from want of use, partly, also, in the position of abduction, on the twist of the pelvis and consequent diminution in the projection of the tuber ischii.

The pain which is experienced is not confined to the hip, but is often referred to the inner side of the knee. It is due probably to pressure on, or irritation of, the branch of the obturator nerve distributed to the capsular ligament and ligamentum teres, referred sympathetically to the terminal cutaneous branches of the same nerve. In the same way, if the articular branches of the anterior crural or sciatic nerves are more particularly involved, we may find the pain referred to the front or outer side of the knee, or even to the heel or ankle. From whatever cause it arises, this pain is sometimes the first symptom which attracts attention, and may lead to mistakes regarding the real seat of the disease. The chance of error is increased if puffiness over the knee accompanies the pain, as it does sometimes; just as swelling of the testicle may be produced by the passage of a calculus along the ureter, from pressure on the spermatic plexus, and consequent nervous disturbance of the nutritive conditions of the parts supplied by its peripheral branches.

In the third stage of hip-disease, all the symptoms are much aggravated. The starting pains are very violent, rendering the nights much disturbed. The limb is still more distorted, and real shortening is often present from the incomplete luxation already described. There is much fever, with increased local heat; suppuration has now taken place, and crepitus may be detected when the articular ends of the bones are moved on each other. When abscesses form, they may point in almost any part of the limb, either in the vicinity of the joint, or after having burrowed among the muscles to a great extent, especially when the erect posture has been long maintained. If the sinus is situated some distance down the thigh, near the inferior attachment of the tensor vaginæ femoris, the probabilities are in favor of the femur being the seat of mischief. When the acetabulum has originated or participated in the disease, and matter has formed in the pelvis, the abscess often shows itself at the outer part of the groin in the neighborhood of the antero-inferior spine of the ilium; occasionally it passes down by the rectum, into which it may burst, or it may reach the surface close to the anus.

[Hip-joint disease may also be confounded in the early stage with sacro-iliac disease and osteitis of the great trochanter, and inflammation of the trochanteric bursa.

Fig. 672.

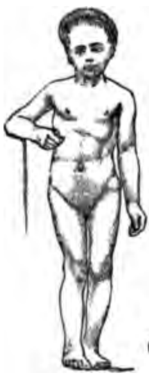


Fig. 673.

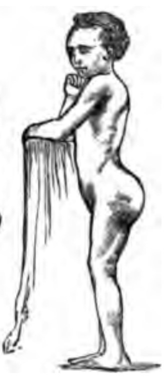


Fig. 674.

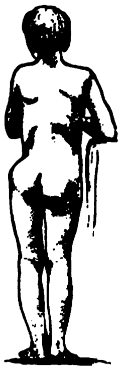


Fig. 675.

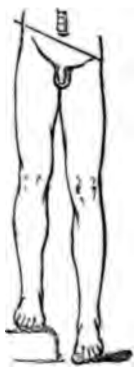


Fig. 676.

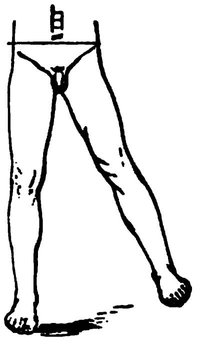


Fig. 672. Case of displacement of both femora; anterior view.
Fig. 673. The same case: side view.
Fig. 674. Displacement of head of left femur; posterior view.
Fig. 675. Apparent elongation of left leg in hip-disease, due to ankylosis in an abducted position. The pelvis is tilted and the leg adducted.
Fig. 676. The same case with pelvis horizontal and leg abducted.

Verneuil mentions a contraction of the adductors of the thigh which simulated hip disease in many respects. This affection is almost always bilateral.[1]

Synovitis of the hip-joint of a subacute

[[1] L'Union Médicale, Sept. 8, 1877, p. 373.]

and chronic character is probably not as rare in the hip-joint as has been supposed.[1]

Pain cannot always be relied upon as a certain diagnostic symptom in the initial stage of hip-disease, or aggravation of the pain when the limb is pressed upward. Limping in gait, and stiffness or limitation to motion, are the earliest symptoms; atrophy and diminution of the electrical contractility are also early symptoms of psoitis which may be confounded with hip-disease.[1]]

Fig. 677.

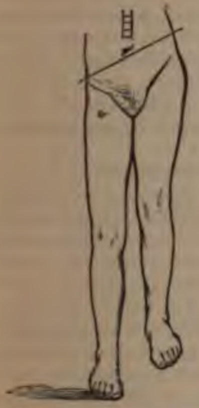


Fig. 678.

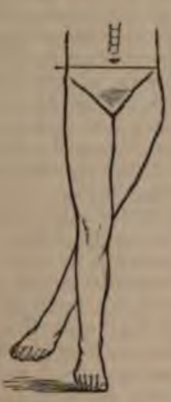


Fig. 677. Apparent shortening of the left leg in hip disease, due to ankylosis in an adducted position. The pelvis is tilted and the leg abducted.

Fig. 678. The same case with pelvis horizontal and leg adducted.

There are one or two points in the diagnosis to which I may briefly direct attention. I have seen congenital dislocation mistaken for hip-joint disease, and the child subjected to much unnecessary confinement and suffering. A little attention readily distinguishes the two affections. The history of the case, and the existence of evident limping from the first moment when any weight was allowed to rest on the limb, the absence of pain, and the extent of real shortening, aggravated when the limb is pressed upwards, diminished when extension is made, are symptoms of congenital dislocation which differ widely from those which would have been presented by severe disease of the joint. We occasionally meet with cases in which a difference in the length of the two lower limbs exists, resulting in some instances from congenital malformation, in others from infantile paralysis, which has led to wasting and defective growth of one extremity. Such a condition, if existing to any extent, causes limping in the act of walking, and leads to secondary deformity of the spine, in the form of lateral curvature, to counteract the tendency of the body to fall towards the affected side. This state might easily be mistaken for diseased hip, as well as for diseased spine, until a careful examination of the whole limb is instituted, when the cause of the symptoms is readily detected.

[Fig. 679.

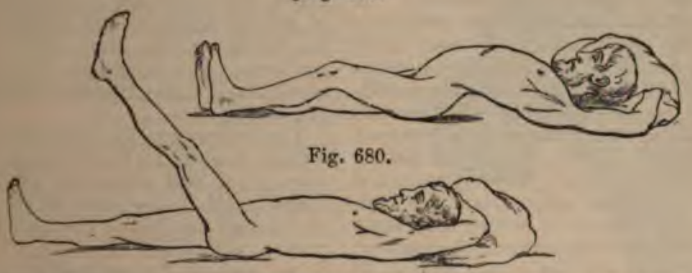


Fig. 680.

Fig. 679. Lordosis of spine caused by hip-joint disease. Appearance in recumbent posture.
Fig. 680. Lordosis effaced by elevating the flexed leg.]

Psoas abscess, with or without disease of the spine, may be mistaken for hip-disease. A case of this kind, where the psoas abscess was connected with extensive tubercular disease in and around the kidney, came under my care at the Hospital for Sick Children, which had been considered and treated previously as disease of the hip. The limb, in such a case, may be flexed on the pelvis, and any attempt at extension give rise to great suffering; it will be found, however, that, provided the psoas muscle is kept relaxed and no traction upon it allowed, free movement of the joint may be effected,

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[[1] Nicaise, Diagnostic des Maladies de la Hanche, Thèse de Paris, 1869; Gibney, Am. Journal Med. Sc., Oct., 1878, p. 383; Morgan, St. George's Hospital Reports, vol. x.; Coxitis Hæmorrhagica, Allg. Med. Cent. Zeitung, Dec. 19, 1877.]

[[1] Thèse de Paris, 1877, No. 526; Œster. Jahr. f. Pædiatrik, viii., p. 177.]

and its articular surfaces rotated on one another or pressed together with much force, but without suffering. The situation of the abscess, also, serves to assist in the diagnosis, for pelvic abscess, depending on hip-joint disease, is almost invariably complicated with sinuses in other situations. Inflammation of the bursa under the psoas-iliac may simulate hip-disease, and be with difficulty distinguished from it. Sometimes, indeed, the bursa communicates with the joint, and disease beginning in one involves the other in its course. If such is not the case, and the inflammation is confined to the bursa, there will be pain and tenderness on pressure at the front and inner part of the joint, with, it may be, some indistinct swelling in that situation; the mass of muscles, however, obscuring the bursal tumor. The limb is usually instinctively flexed on the pelvis, as in hip-disease, and any attempt to extend the limb, or any movement which involves traction on the psoas muscle, is attended with suffering. The diagnostic marks correspond to those just mentioned. If care is taken to avoid any pressure on the bursa, or action of the psoas, the joint may be freely handled without suffering; moreover, no tenderness or swelling can be detected behind the trochanter.

The treatment of strumous disease of hip does not differ materially from that already recommended for strumous inflammation of the joints generally. If detected at the earliest stage, complete rest of the joint, at first in bed, afterwards by means of a splint, which must be long enough to secure perfect immobility of the hip, will be sufficient. But the rest must be continuous and maintained for an adequate period, the general health being at the same time properly attended to. In the second stage, when the limb is apparently altered in length and some starting pains have manifested themselves, confinement to bed for a long period is necessary, and extension by means of weights, to relieve the muscular spasm, may be used in the way already described. If the thigh is flexed and adducted, it must be straightened, which can be done readily enough under chloroform when the disease is recent, and with care and caution even at a later period when adhesions have taken place.

When suppuration has occurred, if the symptoms are not very urgent, it is usually better to abstain from opening the abscess, as absorption may be expected occasionally to take place. If there is great pain, and the matter is too deep-seated to be reached conveniently, relief is sometimes obtained, temporarily at all events, by a few lines of the actual cautery. If the pain and distress are still very great, an opening may be made either with a knife or a trocar. In some cases where it is necessary to let out deep-seated matter, in order to avoid a large vessel, the mode recommended by Mr. Hilton may be employed, viz., after making a small incision through the superficial structures, to force a probe-director through the soft parts into the cavity of the abscess, and when pus flows along the groove of the director, to introduce a pair of fine dressing forceps into the abscess, and enlarge the opening by forcibly separating the blades.

If the case has gone on unfavorably, the bone become carious, and extensive suppuration taken place, resulting in sinuses, the health suffers, and the only chance of recovery, or even of preserving life, may consist in excision of the head of the femur, or removal of the diseased bone. Such an operation, in children at any rate, is more formidable in imagination than in reality, and I have had occasion to perform it without any injurious consequences. The subject of excision, however, has been treated of in a separate essay.

[The proper treatment of "strumous disease of the hip" is at present one of the vexed subjects in surgery; the line of treatment customary in some localities being diametrically opposed to that in vogue in others.

In disease of the hip-joint the muscles about the joint play an important part in the production of deformity, and in the increase of the destructive change in the bone. It is in disease of the hip-joint particularly that extension appears to be of great service.

The indications for treatment demand a protection of the limb from jar, and the prevention and correction of deformity. Certain authorities insist on the necessity of absolute fixation of the limb for a long period, while others claim that, if the limb is so placed the muscular contraction and spasm are overcome and jar to the limb is prevented, motion to a limited extent is not injurious except during acute attacks, when the patient instinctively avoids all movement. Excellent results have been gained by the latter method, which has the merit of permitting locomotion.

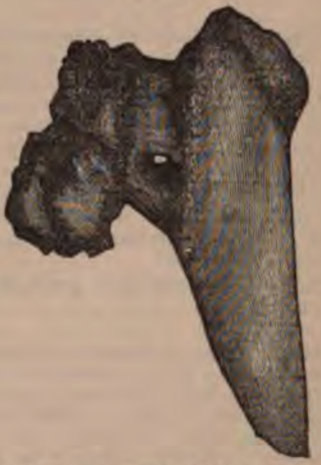
What has been termed the "American Method," is based on the value of extension. The limb is secured firmly by strips of adhesive plaster, a splint, reaching from the hip and bent below the foot, capable of being lengthened by a key and ratchet, is applied with a perineal strap to secure counter-extension; extension is regulated by lengthening the splint to the bottom of which the adhesive plasters holding the leg are secured. The patient is confined in bed during the painful stage, but is allowed to move about at other times, standing upon the splint, which, being longer than the limb, and bent under the foot, bears the weight of the body, the perineal strap preventing the patient from sinking, and touching the floor with his heel. The sound foot is raised, to keep the pelvis even. When thorough extension is applied, but little motion is possible at the hip-joint, and the joint is more thoroughly fixed than would be supposed, so much so that some surgeons believe that the chief benefit from the apparatus is gained from the fixation thereby afforded. Different appliances have been devised and are used, but all are based on the principle of extension.

For the purpose of absolute fixation the gouttière of Bonnet, modified and improved by Bauer and Sayre, enables the patient to be carried about, but does not allow locomotion. To gain this, Mr. Thomas's apparatus has been used extensively in England, and has the advantage of cheapness and is easily applied. The fixation furnished by it is not as complete as that given by the gouttière.

Dr. Hutchison has lately introduced what he terms the physiological method. The patient is furnished with crutches and is allowed to walk about freely; the sound limb being raised by a high sole, and the affected limb allowed to swing. The weight of the limb is supposed to furnish sufficient extension, and fixation is secured by the physiological action of the muscles about the hip. In cases during the painful stage, the patient is confined to bed temporarily, and extension is secured by a weight attached to a cord passing over a pulley and attached to adhesive plaster applied to the limb. Hutchison's method is yet sub judice, and apparently answers in some light cases, but it is certainly not suited for all or the average cases of hip-disease.[1]]

Morbus coxæ senilis.—In advanced life another form of disease is apt to occur in the hip, which is known by the name of the *morbus coxæ senilis* or *chronic osteo-arthritis.* Unlike strumous inflammation, this disease seldom occurs under the age of forty, and often appears as a local affection, without any visible impairment of the general health. In chronic arthritis of the hip, there is stiffness of the articulation, and a certain amount of dull pain extending down the *front* of the thigh; the pain, however, though augmented after much exercise, diminishes during the night, and is not increased even by rough pressure of the articular surfaces against one another. The mobility of the joint is much interfered with, and a loud crackling can be distinctly heard when the limb is exercised. When the disease is well established, the foot is much everted, the nates are flattened, and there is *apparent* shortening of the extremity to a very considerable extent, in consequence of elevation of the corresponding side of the pelvis; a certain amount of *real* shortening may also take place after a time, from the changes which occur in the femur, the head of which may become altered in shape, and flattened, whilst the neck may assume a horizontal direction, so that the upper extremity of the bone may be placed below the level of the trochanter major. At this stage of the disease, too, bony protuberances may perhaps be felt around the articulation. The characters enumerated are so distinct from those of strumous disease of the hip, that mistakes between the two can scarcely arise. From sciatica it is distinguished by the character and situation of the pain, as well as by the presence of shortening of the limb, real or apparent, and eversion of the foot. The appearances presented somewhat resemble those of fracture of the neck of the femur, for which it might possibly be

Fig. 681.



Head and upper part of the shaft of the femur affected with chronic osteo-arthritis. (From a preparation in the Museum of St. George's Hospital.)

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[1] H. G. Davis, Trans. Am. Med. Assoc., 1860; C. F. Taylor, Mechanical Treatment of Hip-Disease; L. A. Sayre, Lectures on Orthop. Surgery; Hugh Owen Thomas, Hip, Knee, and Ankle; Hutchison, Lectures on Orthopædic Surgery.

[2] Boeckel, Des effets de la Coxalgie Infantile sur la croissance ulterieurs du Membre, Archives de Physiologie, vol. 3, 1870, p. 554; Incision of the capsule in Hip-Joint Disease, Hardie, British Med. Journ., Sept. 1, 1877; Hemorrhagic Coxitis, Allg. Med. Central. Zeitung, Dec. 19, 1877.]

mistaken if any injury or accident had previously occurred. The history of the case, however, and the slow and gradual progress of the symptoms, as well as the osseous growths which are apt to form, are sufficient for accurate diagnosis. Where constitutional symptoms are present, the disease extends to other and smaller articulations, and the character of the affection cannot fail to be recognized.[1] The treatment of this affection is noticed in the section on Chronic Rheumatic Arthritis.

Neuralgia of the hip.—This joint is frequently the seat of hysterical pain, closely simulating structural disease. The diagnostic characters of this affection have already been pointed out (see Articular Neuralgia). It may be remarked, however, that apparent shortening of the limb may be present in these cases, owing to alteration in the direction of the pelvis and its relation to the vertebral column, induced by long continuance in one unnatural posture. Lateral curvature of the spine also is frequently noticeable; but the nates are not flattened, and abscesses do not form.

Diseases of the Pubic, Sacro-iliac, and Sacro-coccygeal Joints.

These articulations, in consequence of their anatomical arrangement, are less exposed to disease than the proper diarthrodial joints of corresponding size.

As a consequence of hip-disease, especially in early life, the pelvic articulations become unusually movable; to such an extent indeed, that rigidity, or even complete ankylosis, of the diseased hip-joint may be attended with but little loss of the mobility of the limb.

Disease of the symphysis pubis is very uncommon.

A case, however, of extensive ulceration of its fibro-cartilage, with superficial caries of the articular surfaces of the contiguous bones, accompanied with a large abscess in the sheath of the rectus, occurring in a female, will be found in the fifth volume of the Pathological Transactions. Dr. Humphry also quotes a case related by Otto, in which the symphysis, as well as the right sacro-iliac joint, were completely ossified in a middle-aged woman. Two other cases of ossification are also referred to, but ankylosis is undoubtedly very rare.

Acute inflammation of the sacro-iliac joint may result directly from injury. A case is related by Louis in which a sack of corn fell on the loins of a man who was stooping at the time. The accident gave rise to some swelling of the part, followed after a time by violent pain and much febrile disturbance, and death ensued at the end of the twentieth day. Very extensive inflammation, attended with suppuration, was found in the right sacro-iliac articulation, and the bones were separated to a certain extent from one another.

Disease of the sacro-iliac joint may arise in connection with pregnancy or parturition. During pregnancy the union between the pelvic bones is said to become less firm, and in certain cases the relaxed condition of the sacro-iliac joint is so considerable as to give rise to pain, as well as to difficulty in standing or walking; during exercise, too, the patient may be sensible of a certain amount of motion between the sacral and iliac bones, and sometimes a distinct "crackling" can even be heard. In most of these cases the ligaments resume by degrees their normal condition, and the pain and limping gradually subside. Occasionally, however, the relaxed condition may last for a considerable period, and the limping may continue for months or years, or even, according to Ludovic, for the remainder of life. It may happen, too, that actual inflammation of the joint is set up; the pains become violent; there is swelling about the part; and if suppuration takes place, the case is most likely to terminate fatally.[1]

Sir B. Brodie relates the case of a married lady who was unable to walk without crutches, and who experienced pain after taking exercise, referred to the right groin as well as to the right sacro-iliac articulation, where a projection existed, as if the ilium had been displaced and drawn upwards; the affected limb was two inches *shorter* than the sound one. Pains resembling sciatica had been complained of for many years, but the first distinct symptoms of the affection appeared to be referred to her pregnancy, four years previously. Recovery took place, though the limb remained permanently shortened. Mr. Hilton also relates a case of sacro-iliac disease, occurring after parturition, attended with suppuration within the pelvis, in which the abscess subsequently became absorbed, and a cure was ultimately effected after prolonged mechanical rest.

The chronic form of *sacro-iliac disease* is often traceable to some local injury, though Mr. Erichsen (to whom we are indebted for a very excellent description of this affection) considers it to be usu-

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[[1] Senile alterations in joints; arthritis deformans. Weichselbaum, Allg. Med. Centr. Zeitung, March 15, 1878.]

[1] See Desormeaux, Sur les Relâchements, Écartements, etc., des Symphyses du Bassin.

ally strumous in its origin. The symptoms consist mainly in pain in sitting and standing, or even lying on the affected side, as in any of these positions the weight of the body tells upon the inflamed part. The pain may be localized by direct pressure on the affected joint, or by pressing the bones together or the sacrum forwards, and in many cases a little puffiness with some elevation of temperature may be detected in the sacro-iliac region. Frequently, however, as Mr. Hilton points out, the actual seat of the disease may be masked by the pain being referred (through the nerves in relation with the joint), to the hip, knee, or back part of the calf, whilst the psoas muscle may be kept spasmodically contracted from nervous irritation, giving rise to a flexed condition of the hip. There is an absence, however, of any increased warmth in these parts, and by taking care to keep the pelvis quite at rest, the other joints may be moved freely without producing pain. When suppuration takes place, and in most cases it only does so at a late period of the disease, the matter may point posteriorly in the immediate neighborhood of the articulation, or may extend outwards to the great trochanter, or upwards to the loin; if, on the other hand, the matter accumulates in front of the joint, it may pass into the perineum or even open into the rectum, or it may leave the pelvis by the great sciatic notch and point in the gluteal region.

The affections with which sacro-iliac disease is most likely to be confounded are diseases of the hip and spine, but by careful attention to the points indicated, the real seat of the mischief can generally be made out satisfactorily, except, perhaps, when the disease is situated at the junction of the last lumbar vertebra and sacrum, and affects mainly one side.

When sacro-iliac disease is in an advanced stage, and especially when matter has formed to any extent, the prognosis is by no means favorable. In an earlier stage, however (and hence the importance of accurate diagnosis), a cure may not unreasonably be expected, as Mr. Hilton relates several cases, occurring at varying ages, to show that by giving perfect and prolonged rest in the recumbent position, and by steadying the pelvic bones by means of a strong and broad belt so as to favor ankylosis, recovery will often take place.

[Sacro-iliac disease was first mentioned by Boyer in 1821, and later attracted the attention of a number of French observers. The disease is uncommon, but probably more common than is supposed. The most prominent symptom is lameness; the buttock is often flattened, and the thigh and leg emaciated. Local swelling is an early symptom, but it is not always present. Abscess only appears at a late stage.

The affection appears to be most common in adults, but Poore has reported two cases occurring in children aged, respectively, four and five. Out of fifty-eight cases, collected by Poore, recovery was reported in twenty-three. Le Dentu mentions a case following gonorrhœa.

The diseases with which it is liable to be confounded with are :—

Sciatica.
Lumbago.
Psoitis.
Hysterical coxalgia.
Caries of the spine in the lower lumbar region.
Coxalgia.

Characteristic of sacro-coxalgia are the following symptoms: a peculiar projection of the affected side when the patient stands, avoiding pressure upon the inflamed articulation; tenderness over the sacro-iliac articulation; free motion at the hip-joint if the pelvis is fixed, provided no pelvic abscess is present; pain on pressure of the iliac bones together. At an early stage of the disease flexion of the thigh or lordosis is not present. Walking is more painful than in hip-disease, and there is greater relief from rest. Pain along the thigh may be present, but pain referred to the knee is wanting; the point of the foot is not turned from the median line, *i. e.*, no eversion or inversion is present. Nocturnal pain is absent.[1]]

Disease of the sacro-coccygeal joint is occasionally met with as the result of injury, and, for anatomical reasons, more frequently in females than in males, in early life than at an advanced age. The symptoms, as described by Mr. Hilton,[2] are tenderness with increased heat about the joint; pain on defecation as well as on rising from a seat or sitting down, and on walking or running rapidly, the pain in these movements being caused by the action of the corresponding muscles attached to the coccyx. There is also pain on direct pressure on the joint, and on moving the coccyx when grasped between the thumb and the forefinger introduced into the rectum. Rest in the recumbent position, and the prevention of constipation by appropriate diet and the use of laxatives, constitute the treatment recommended.

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[1] [Recent articles on the subject of sacro-iliac disease: Delens, Sacro-coxalgie, Paris, 1872; LeDentu, Gaz. Hebd., Feb. 23, 1877; Heath, Brit. Med. Journ., Dec. 16, 1876; Charon Presse Médicale, 1877, xxix., No. 11; Poore, American Journal of Med. Sc., Jan., 1878; also Sayre, Lectures on Orthopædic Surgery, Virginia Med. Monthly, May, 1878, p. 81; Pooley, N. Y. Med. Journal, Sept., 1878, p. 314.]

[2] Hilton, On Rest, p. 424.

It may be remarked that symptoms very nearly resembling those mentioned are often met with in hysterical females. In these cases, however, the temperature about the part is not increased, and there is an absence usually of pain when the coccygeal bones are moved in the way previously described.[1]

Diseases of the Knee.

The diseases of the knee have been studied with extreme care, owing to the frequency of their occurrence, as well as to the size and accessible position of the articulation.[2] Hence it is that the affections of this joint are often taken as typical of articular disease generally. The knee is liable to the various morbid changes which have been described in the first part of this essay; to one of them, indeed—chronic inflammation of the articular extremities of the bones—it is specially exposed, for *local abscess* is more common in the head of the tibia than in any other situation; and necrosis of the lower end of the femur is often met with, at first simulating, but subsequently inducing, suppuration of the joint.

The position which the limb habitually assumes in severe disease of this articulation, whether simply inflammatory or strumous in its origin, is one of considerable flexion, frequently combined with torsion, in consequence of eversion or inversion of the foot. If the ligaments become extended or destroyed in the progress of disease, the spasmodic contraction of the flexor muscles acts upon the head of the tibia, which it tends to dislocate backwards into the popliteal space. In our treatment, therefore, we have to guard against this tendency; the foot must be supported to prevent torsion, the limb must be maintained uninterruptedly in a nearly *straight* position, and extension by weights may be used as in the case of hip-disease.

In *chronic osteo-arthritis*, the knee-joint soon acquires a strong inclination *inwards*, whilst the tibia is usually rotated outwards and the foot everted. At a more advanced period, if the limb becomes rigid in a semi-flexed position, the patella is occasionally found resting on the outer condyle of the femur, or even completely dislocated outwards. The amount of synovial effusion is considerable in the earlier stages of the disease, and the swelling will often be found to extend to the popliteal space in the direction of the inner head of the gastrocnemius, owing to distension of the bursa which exists in this situation, and which frequently communicates with the joint. As the disease advances, the patella becomes increased in breadth, and ossific deposits may be distinguished at the condyloid margins of the femur and on the head of the tibia. Pendulous excrescences, or completely detached bodies (loose cartilages), are frequently to be found in the interior of the articulation.

The *deformities of the knee*, and the treatment they require, are discussed in the essay on ORTHOPÆDIC SURGERY.

Inflammation or dropsical distension of various bursæ in the neighborhood of the knee-joint may often be met with. Besides the superficial bursa over the patella, which gives rise in its diseased condition to "housemaid's knee," there is a deep-seated bursa between the ligamentum patellæ and the tibia, which may also be inflamed, producing pain on motion, with ill-defined enlargement in the region of the anterior tuberosity of the tibia. Occasionally that part of the synovial membrane which extends upwards beneath the extensor muscles is replaced by a bursa, which may be quite distinct from the knee-joint; or an imperfect division of the membrane into two cavities may exist. When a separate bursa is present, it may be inflamed and give rise to painful swelling, which is confined, however, to the region above the patella, the articulation below remaining unaffected: this diagnostic mark is most evident when the patient is in the erect position. A swelling is often met with, especially in children, at the inner side of the popliteal space, connected with the bursa placed beneath the inner head of the gastrocnemius. As this latter bursa frequently communicates with the synovial membrane of the joint, inflammation of it is a matter of some importance, and care must be taken in our surgical treatment. Inflammation may also take place in the bursæ in connection with the *patte d'oie* tendons at the inner side of the head of the tibia, leading occasionally to most obstinate and prolonged suppuration, and interfering with the movements of the joint, which does not, however, *directly* suffer.

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[1] [Relaxation of the pelvic symphyses in relation to pregnancy; Snelling, American Journal of Obstetrics, vol. 2, No. 3, 1870.]

[2] [Ashhurst, Operative and Conservative Treatment of Diseases of the Knee, Trans. College of Physicians, Philadelphia, 3d s., ii., p. 49. Antiseptic incision, in Berliner Klin. Woch., Aug. 6, 1877, p. 461: Ibid., Aug. 13; Ibid., p. 513; Osteitis of Knee, Berry, New York Med. Record, Jan. 31, 1880; Intermittent Hydrops Artic., Seeligmüller, Deutsche Med. Woch., 1880, No. 5. Excision of the knee-joint belongs to another portion of this work. See also Fagan, Dublin Journ. Med. Sc., Nov., 1877; Treves, Brit. Med. Journ., 1877, p. 133; Fenwick, New York Med. Record, Jan. 26, 1878.]

It may be remarked, that in *wounds of the knee-joint*, when suppuration occurs, it may take place insidiously, in the areolar tissue between the thigh-bone and the muscles which surround it, rather than in the articulation itself. In this way the whole thigh may be inflamed and swollen, and the appearances somewhat closely resemble those of acute periostitis of the femur. The depth at which the matter is situated prevents it from coming rapidly to the surface, and does not readily allow of fluctuation being detected. Much constitutional disturbance is, consequently, usually present, and the amount of pus which forms before an outlet is obtained is often very large. In such cases early and deep incisions are obviously called for; incisions which shall extend through the whole muscular layers, if the seat of the suppuration is to be reached, and the symptoms produced by the pent-up matter abated.

Diseases of the Ankle.

The ankle-joint is liable to the various diseases which have been already described, and is often involved in the progress of caries affecting the irregular bones of the tarsus; occasionally, indeed, it is not easy to decide whether the disease actually affects the ankle, or is confined to the astragalus or calcaneum; the point may, however, be determined by the free motion in the latter case of the ankle-joint when the patient is placed under chloroform. When the joint is distended with fluid, the tumefaction and fluctuation are most evident between the two malleoli, on either side of the extensor tendons; in extreme cases the effusion is perceptible also posteriorly, at the inner and outer borders of the tendo Achillis. When suppuration occurs, the matter may make its way to the surface in the immediate vicinity of the joint, or it may ascend the leg, or descend into the foot in connection with the tendinous sheaths around the ankle, so as to open at a considerable distance. The direction which the foot is prone to assume in disease interfering with the use of the joint is that of flexion, combined generally with varying amounts of inversion or eversion. The position to be selected, on the other hand, to avoid present stretching of the ligaments, and as most useful in the event of ankylosis, is that in which the foot is in the same plane with the leg, and forms with it an angle only slightly exceeding a right one. It may be remarked that disease of this joint is more favorably situated for recovery than disease of the thigh or knee, because, by the employment of a wooden leg, whilst the ankle is carefully supported by splints, exercise may be taken, and the general health consequently maintained.

Chronic osteo-arthritis seldom affects the ankle, but when it does, the tarsal joints are usually implicated at the same time. Increase in the breadth between the malleoli, which are preternaturally prominent, combined with projection inwards of the scaphoid and depression of the instep, are the appearances commonly noted.

[The subject of excision belongs properly to a different portion of this work, but it has lately been brought into prominence in discussing the treatment of joint affections.

Since the introduction of antiseptic surgery, conservative surgery, *i. e.*, the treatment without amputation or excision, has received valued reinforcement by the introduction of incisions into the joint, which in the knee-joint has been shown to be of less danger than was formerly believed to be the case.

Excision is, in the treatment of the larger joints, hip and knee, to be regarded at present as a procedure to be used when it is impossible to carry out the expectant plan, for which a long time is needed. Mr. Holmes claims that the results after excision of the hip-joint are not, as far as usefulness of the limb is concerned, as successful in its results as expectant treatment. It must be confessed, however, that much better results have in the last decade been reported after excision than were commonly attained before.[1] The advantages of conservative surgery in caries of the ankle (including the tarsus) have been urged in a paper recently presented to the Therapeutical Society of New York, based on a study of 16 cases. In 14 of these recovery took place after a period of two and a half years, and 2 died from exhaustion after suppuration. The treatment consisted of incision whenever pus came to the surface, and the removal of loose bone, but without excision.[2]]

Diseases of the other Articulations of the Foot.

The tarsal bones are so small, and the articulations between them so numerous and in such close proximity, that distinctions between the morbid conditions of the two can with difficulty be drawn. Disease in the tarsus, in the majority of

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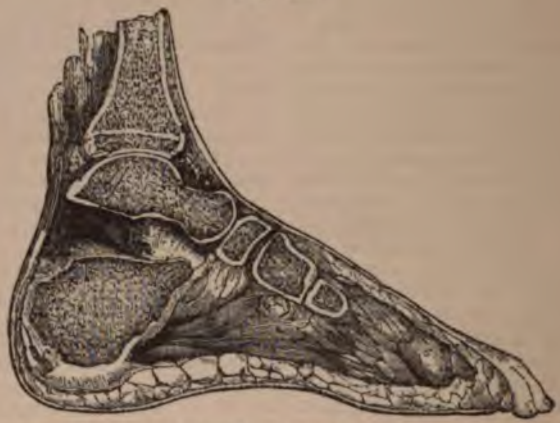
[[1] Brit. Med. Journal, 1880, Aug., p. 252; also Med. Times and Gazette, Nov. 3, 1872.]

[[2] New York Med. Record, Aug. 21, 1880.]

cases, arises in strumous inflammation of the bones, which soon extends to the cartilages and to the synovial membranes. Occasionally, however, an articulation is the starting-point, as may be seen represented in the accompanying illustration (taken from a preparation in the St. George's Hospital Museum), in which the disease is found commencing in the joint between the astragalus and calcaneum.

Fig. 682.



Disease of the tarsus, commencing in the joint between the os calcis and astragalus. (From a preparation in the Museum of St. George's Hospital.)

Some importance must be attached to the original seat of the mischief, in consequence of the varying degrees of simplicity of the synovial membranes; of these, the median, or *scapho-cuneiform*, is by far the most complicated, as it extends between so many tarsal bones. When disease involves only the simpler synovial membranes, or is confined to single bones in connection with them, the probabilities of a successful issue are comparatively great; and if operative measures are necessary, excision of individual bones may be had recourse to with satisfactory results. I have several times removed the calcaneum, the cuboid, or even the internal cuneiform, and recovery has occurred with a very useful foot. When disease affects the astragalus or the scaphoid, on the other hand, and the contiguous synovial membranes are implicated, the chances of localizing the mischief become much diminished; though one or both of these bones can often be removed successfully, leaving a very effective foot.[1] The middle and external cuneiform bones, also, are unfavorably situated, though less so, perhaps, than the astragalus or scaphoid. It may be remarked, that the repair which takes place after excision in these cases is usually most complete, for a large portion of the periosteum is, and ought to be, left behind in the operation; reproduction of the bone consequently occurs to a greater or less extent, giving to the foot all the solidity which is required. After removal of the whole of the calcaneum, I have found the heel perfectly rigid, and the amount of deformity very trifling.[1]

[Two cases with autopsy are reported in Gaz. des Hôpitaux, April 28, 1877. The affection is said by Gosselin to be most common in adults. There is no alteration in the position of the foot, and no deformity. The pain may be quite acute on pressure near the scaphoid. Motion of the foot is not painful, but the patient may be unable to bear any weight upon the foot.[2]]

Inflammation of the complicated *scapho-cuneiform* synovial membrane may be looked upon, according to Mr. Erichsen, as a distinct affection of the foot, commencing usually in disease of the scaphoid. At first there is pain and swelling in the region of the joint between the scaphoid and cuneiform bones. The pain is increased by bending down the foot, and extends across the tarsus to its outer side, as the articulation between the external cuneiform and the cuboid becomes involved. At a later period "the foot assumes a remarkable bulbous or clubbed appearance; the symmetry of the heel and the outline of the ankle are unimpaired, but the fore part and dorsum of the foot are greatly swollen, glazed, and possibly perforated by sinuses discharging their unhealthy pus."[1]

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[1] See Holmes, Surgical Treatment of Children p. 502 et seq.

[1] See also Pathological Transactions, vol. xi., p. 217, for an account of the condition of the parts in a foot from which I had removed two of the tarsal bones.

[[2] Also Gaz. des Hôpitaux, Oct. 6, 1877, p. 922; Chambard, Thèse de Paris, 1877; Tarsalgia des Adolescents; Duplay, Gaz. des Hôp., Oct. 9, 1879.]

The diseases of the metatarsal and phalangeal articulations call for no special observations. They are frequently *gouty* in their character, or, in some cases, are examples of *chronic osteo-arthritis*. It is worthy of notice, perhaps, that in the metatarso-phalangeal articulation of the great toe, the deformity induced by the latter affection has been mistaken for dislocation; a condition which it may closely resemble.

The subject of *bunion* is considered in the essay on SURGICAL AFFECTIONS OF THE SKIN.

Diseases of the Sterno-clavicular, Acromio-clavicular, and Sternal Joints.

A certain amount of enlargement of the *sterno-clavicular* as well as of the *acromio-clavicular* articulations may sometimes be seen in persons who have long been in the habit of working hard with their upper extremities. Acute inflammation of the *sterno-clavicular* joint is also met with occasionally. Such a case in an adult came under my care, in which suppuration rapidly took place, with destruction of the fibro-cartilage, inducing spontaneous dislocation of the inner extremity of the clavicle. The shoulder and arm having been fixed, and the dislocation reduced and prevented from recurring by appropriate splints, recovery took place with a useful extremity.

Disease of this joint is easily recognized, but, owing to the great mobility and peculiar anatomical characters of the articulation, it is difficult to secure perfect rest, and, for like reasons, ankylosis is seldom met with. Cases of sterno-clavicular disease will be found related in Mr. Hilton's work on Rest, and in the Lancet of April, 1864.[2]

Chronic osteo-arthritis of these articulations may also occur, producing enlargement of the articular extremities of the clavicle, stiffness and pain on movement of the joints, as well as weakness of the upper extremity.

Disease of the *articulation between the first and second pieces of the sternum*, where no synovial membrane exists, is rare, but an interesting case is related by Mr. Hilton, in which the principal symptoms were pain about the sternum, especially on coughing or talking, or making any respiratory exertion, with difficulty of breathing, and great tenderness on direct pressure on the joint. Recovery ultimately took place.

Diseases of the Shoulder.

The shoulder-joint resembles the hip in its anatomical characters, but is, fortunately, far less subject to disease, and when disease occurs the results are usually much less severe, the persistence of pain and the production of rigidity constituting the conditions most to be apprehended. If suppuration takes place, which is seldom the case, the matter often follows the course of the long tendon of the biceps, and opens at the front of the arm below the deltoid. Not unfrequently, too, it passes out of the articulation by the opening which exists in the synovial membrane beneath the subscapularis, and follows that muscle, arriving at the surface near the back and lower part of the shoulder. The most favorable position in which a diseased shoulder can be placed for treatment, is that which is almost naturally adopted; the arm should be parallel to the trunk, and the elbow slightly separated from the chest, the forearm being at the same time supported by appropriate mechanical means. If ankylosis takes place, owing to the great mobility of the scapula, the arm may still be moved very freely, and the limb consequently remains very useful.

The condition of parts induced by *chronic osteo-arthritis* of the shoulder has, no doubt, been frequently mistaken for the result of injury. After the stage of synovial distension has passed, wasting of the soft parts occurs; rigidity, as well as crepitation on movement, are met with, and the head of the humerus appears to be elevated and carried forwards. When the disease is of long standing, the deltoid is atrophied. The capsular ligament is usually thickened, and has sometimes osseous particles in its substance, or it may be perforated at its upper part. The synovial membrane shows marked signs of inflammation. The glenoid fossa loses its ligament as well as its cartilage, and presents the characteristic ivory-like material; occasionally, too, irregular osseous growths are found around its edges, increasing its capacity. The under surface of the acromion, and even of the acromial end of the clavicle, may be hollowed out by pressure of the humerus upon them, and are often covered with a polished porcelain-like material. Separation of the acromion into two portions is also met with sometimes. The head of the humerus is often much enlarged, and its surface eburnated. The tendinous structures around the joint may appear partially disintegrated, and the intra-articular part of the long head of the biceps is usually destroyed, the remains of the tendon adhering to the edges of the bicipital groove.

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[1] Erichsen's Science and Art of Surgery, 3d ed., p. 715.

[[2] Lancet, 1876, vol. ii., p. 748; Centralblatt f. Chirurgie, No. 10, 1877]

Disease of the *deep-seated bursæ* around the shoulder-joint is occasionally met with, and may prove somewhat perplexing. The bursæ beneath the *subscapularis* and the *infra-spinatus* habitually communicate with the synovial membrane, so that their diseases are in fact those of the articulation itself. The bursa beneath the *deltoid* is distinct; and when that bursa is inflamed, the muscle is rendered unusually convex, and any contraction of it is attended with pain. The articular surfaces, however, can be freely pressed together, and the joint exercised without suffering, provided the deltoid is not used, and no pressure is made on the tumor. A sensation of fine crepitation can often be felt in these cases on moving the shoulder.

[Duplay has described as periarthritis of the shoulder-joint the condition of stiffness or limited motion which is not infrequently seen following comparatively slight injuries. A certain amount of pain accompanies motion beyond a certain extent, although some motion is possible by reason of the mobility of the scapula. Atrophy of the muscles is present, and at times some spontaneous pain. The arm becomes useless, and the affection does not improve without treatment. Forcible motion breaks down adhesions and usually effects a complete cure, but sometimes two or three attempts are necessary before complete recovery.[1]]

Diseases of the Elbow-joint.

The diseases of the elbow resemble those of the knee, although they are less severe in their character, and more favorable in their results. This remark, indeed, applies, for obvious reasons, to all the articulations of the *upper* as compared with those of the *lower* extremities. When effusion takes place into the synovial membrane of the elbow, the swelling is most evident at the back of the arm, on each side of and above the olecranon; it is also perceptible at the outer side of the forearm, beneath the extensors. If suppuration occurs in the joint, the direction in which the matter can make its way with the greatest ease is upwards and backwards between the humerus and triceps; abscesses point, therefore, usually at the borders of this muscle, the outer being the border more commonly selected. The synovial capsule may also give way in front, in which case sinuses will be met with at the side of the brachialis anticus. If the bones are diseased, however, the fistulous orifices may lead directly to the part which has become necrosed or carious. In cases of *strumous osteitis*, which is somewhat common in this region, complete death and separation of a portion of bone in the olecranon, or in one of the condyles, frequently *with* but sometimes *without* the existence of caries, is by no means unusual. A comparatively slight operation, therefore, is occasionally successful in cases where excision of the articulation might at first sight have appeared necessary. The radius, it may be remarked, is less prone to suffer than either the humerus or the ulna.

The position in which the joint should be placed when splints are required, is that in which the forearm forms a right angle with the arm, and is in a state intermediate between pronation and supination. As the joint naturally falls into this position in consequence of its affording the patient the greatest amount of relief, secondary dislocation is rare, the only one which is met with being luxation of the head of the radius outwards and backwards, depending probably on the hand having been kept in a state of forced pronation.

Chronic osteo-arthritis, when it attacks the elbow, is seldom confined to a single articulation, so that the nature of the affection is usually clear. Bony nodules and vegetations are of frequent occurrence in this disease, taking the form occasionally in the ulna of "additamentary bones." Detached or pendulous bodies are often met with, sometimes in great numbers.

Disease of the bursa over the olecranon, constituting "miner's elbow," can scarcely be confounded with disease of the joint. When inflammation attacks the bursa beneath the triceps, however, more care is necessary. According to Mr. Barwell, the condition here closely resembles that which is met with in the knee; a synovial bag existing between the triceps and the humerus, which may be a distinct bursa, or, as is more commonly the case, be a prolongation of the articular synovial membrane. Mr. Barwell remarks that, in inflammation of the bursa when it does *not* communicate with the joint, "there will be no swelling or puffiness between the inner condyle and olecranon process when the arm is bent at right

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[[1] Duplay, Periarthrite Scapulo-Humerale, Arch. gén. de Méd., Nov., 1872, 513; Desplats, Gaz. Hebd., June 14, 1878; Marsh, St. Bartholomew's Hospital Reports, vol. xiv., 1878, p. 339; Paget, Brit. Med. Journ., 1867, vol. i., p. 1; Hood, Bone-setting, Lond., 1871.]

angles; but the infallible test is, that the line of junction between the head of the radius and the humerus is as clear and well-defined as ever. If, on the other hand, the inflamed structure communicate with the joint, then these parts will participate in the general puffiness and swelling.[1]

Diseases of the Wrist, and other Articulations of the Hand.

The complicated relations of the various synovial membranes at the wrist and around the carpal bones facilitate extension of disease from one to the other; the anatomical arrangement explains also, to a certain extent, why it is that the bones are so frequently affected in articular disease of this region. The most favorable position in which the hand can be placed in disease of the wrist is one intermediate between flexion and extension, as well as between pronation and supination. This position is the one naturally adopted when the hand and arm are supported in a sling. In the recumbent posture, however, the hand usually lies on a cushion in a state of complete pronation: a condition which places the posterior ligaments on the stretch, and favors luxation backwards, the only form of spontaneous dislocation to be apprehended. In acute inflammation of the wrist, therefore, relief may often be afforded by so adapting the mechanical support as to obviate this tendency to pronation. If luxation of the ulna has already occurred, and the triangular fibro-cartilage been destroyed, the hand must be secured in the position recommended, and pressure exercised on the back of the ulna to reduce its dislocation, and maintain the bone in its normal position. As stiffness of the fingers is very apt to occur from want of exercise in cases of diseased wrist, passive motion of their articulations must be had recourse to as early as possible.

Chronic osteo-arthritis of the wrist is most common in females beyond the middle period of life, though it is met with occasionally at an early age in both sexes. The back of the wrist in this form of disease exhibits usually a peculiar projection in consequence of enlargement and partial luxation backwards of the ulna, and, though to a much less degree, of the radius. The fingers are frequently distorted, becoming permanently flexed as well as adducted; the *second* phalanges, however, of the fingers, as well as of the thumb, are usually *extended*, giving to the hand a peculiar appearance highly characteristic of the disease in its advanced stage. Enlargement of the articular extremities of the fingers is very common, representing the "nodosities" of Dr. Haygarth. Partial or complete luxations of them may also be present.

Synovial tumors, or "ganglia," about the wrist are treated of in the essay on AFFECTIONS OF THE MUSCULAR SYSTEM.

Diseases of the Temporo-maxillary Articulation.

The only affection of this joint to which it is necessary specially to direct attention is *chronic osteo-arthritis.* This disease usually attacks the jaw in old persons, though it has been seen in early life; generally speaking, too, it is constitutional rather than local, and shows a marked disposition to symmetrical disturbance. The condyle and ramus of the lower jaw are usually enlarged and elongated; in a case related by Cruveilhier, however, the condyle was found to be entirely absent. The glenoid cavity is more or less altered, being frequently enlarged, and sometimes forming a plane surface. The articular cartilage and fibro-cartilage generally disappear, but the porcelain deposit is not common, and foreign bodies are rarely, if ever, present. The symptoms consist principally in stiffness of the jaw, and inability completely to open the mouth, with a crackling noise when the joint is used. The face is distorted; if only one articulation is affected, there will be some projection, and the face is turned towards the opposite side. When both articulations are diseased, the whole jaw is carried forwards. The symptoms are commonly less urgent than those presented by the same disease in other joints, but Dr. Humphry refers to a case in which this disease caused so much discomfort and distortion of the face, that he was led to excise the condyle of the affected joint, and with very good result.[1] A case, too, is related by Mr. Hilton, in which osseous ankylosis of this articulation had occurred to a considerable extent on both sides, in a man in whom ankylosis was also found between the skull and atlas, as well as between some of the succeeding cervical vertebræ.[2]

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[1] Barwell, On Diseases of the Joints, p. 347.

[1] Humphry, On the Human Skeleton, p. 306.

[2] Hilton's Lectures on Rest, p. 105; [Gaz. des Hôpitaux, 1878, Nos. 127, 129; Lignal, Thèse de Paris, No. 411, 1879; Marsh, Lancet, July 31, 1880.]

DISEASES OF THE SPINE.

By Alex. Shaw, Esq.

Revised by E. H. Bradford, M.D.

The spine is subject to a disease, commencing in its bones and joints, so formidable in its results, that it is emphatically called Disease of the Spine. From Caries being the kind of morbid action which invades the bony structures, that term is sometimes used to designate the disease. Owing to an angular projection or hump being formed in the spine at the chief seat of the disease, and to distinguish it from Lateral Curvature, the name Angular Deformity is sometimes applied. The term Malady of Pott, derived from the first standard description of the disease having been given by our countryman, is still occasionally met with, but only in foreign works.

Disease of the spine is correctly included among those of the joints generally. The morbid action which leads to the destruction of parts of the bodies of the vertebræ and fibro-cartilages, is identical with what attacks other articulations. But as the spine combines several offices essentially distinct from each other, such as being a flexible column and at the same time the guardian of the spinal cord, its diseases present special characters, which justify their being treated of separately.

[The pathology of bone has recently been the subject of careful investigation, and particularly the morbid processes to be found in suppurative joint affections, and the kindred disease caries of the spine. Köster and others have demonstrated that miliary tubercles are almost invariably to be found in fungous arthritis, and conclude that the process must be regarded as essentially a tuberculous one. Feurer[1] has recently examined, with reference to this point, 12 specimens of caries of the spine; in nine of these miliary tubercles were found in the diseased tissue, with suppuration in four; tubercles were to be found in other organs also. In the remaining 3 specimens, no tubercles were found in the bony tissue. In 1 of these, however, miliary tubercles were found in the pericardium, but not elsewhere; in this case suppuration was present, but it was absent in the other two.

As elsewhere in similar affections, the first known pathological change consists of increased vascularization; widening of Howship's lacunæ; inflammatory changes in the marrow follow, the normal fatty tissue is replaced by granulation-cells which may undergo fatty degeneration; the lacunæ become enlarged, are filled with cellular tissue, and the bony substance is absorbed or necrosed. It is as yet undetermined whether the vascularization of the bone-tissue is the result of an increased flow of blood in the canaliculi, or to the extension of new vessels from the marrow. Authorities differ also as to the part played by the osseous substance in this process of inflammation, whether the tela ossea is simply inert and is absorbed, or whether the bone-corpuscles primarily undergo degenerative changes.[1]]

Caries: ulceration.—The disease called caries is generally considered to be a morbid process confined to bone. The part of the bone attacked, commonly circumscribed within a small area, at first, is gradually consumed by disintegration and absorption. The fibro-cartilages contiguous to the diseased bone undergo what appears a similar and simultaneous destruction of substance. And during the process, there is a constant discharge of pus, both from the bone and the cartilages. Hence it may be concluded that the diseased action in bone called caries, is the same that, witnessed in the fibro-cartilages, is called ulceration.

The question has been mooted as to whether the morbid process commences in the osseous or fibro-cartilaginous structures. It seems enough to know that when the disease has proceeded for a short time, all the textures yield indiscriminately to its destructive agency. In childhood, temporary cartilage enters into the composition; yet we find that bony, fibrous, fibro-cartilaginous and simply cartilaginous tissues are all disintegrated and removed in an apparently identical manner.

[Simple as the diagnosis of caries of the spine is when a marked projection of the spinous processes can be determined, in the earliest stages the disease is not always so readily recognized.

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[1] Virchow's Archiv, 1880, p. 89.]

[1] Cadeillan, Paris, 1880. De l'osteo-myelite aigue des corps vertebraux, cause du mal de Pott.]

Stiffness of the back at the affected portion is very characteristic, and is due to muscular contraction similar to that seen about affected joints. In cervical caries this frequently gives rise to torticollis, and in dorsal disease, in some instances, a spurious lateral curvature may for a while mask the incipient Pott's disease. When the lower dorsal or lumbar region is affected pronounced lordosis is often to be seen, and in caries in a higher part of the spine the patient will sometimes throw the head back to prevent its weight from bending the spine forward and crowding the diseased bodies together.

The phenomena (strictly nervous in character) vary according to the location of the disease. When the upper dorsal and cervical region is involved, a "grunting" respiration and cough and attacks of severe dyspnœa may take place. Patients with incipient caries of the spine have frequently been treated as asthmatic or suffering from bronchitis.

In a similar way, disturbance of digestion, "dyspepsia," with occasional attacks of vomiting, severe abdominal pain, "gastralgia," vesical irritation with severe pain in the testicles and penis, follow disease of the corresponding portion of the spinal column. The most notable example of this was furnished by a patient who underwent the operation of lithotomy for symptoms which on autopsy were found to be due simply to caries of the spine in the lumbar region.[1]]

Anterior segment, the special seat of the disease.—An important distinction exists as to the segment of the spine to which the morbid action confines its attacks. It is a remarkable pathological fact, that spinal disease selects the bodies of the vertebræ, the fibro-cartilages, and the accessory ligaments, forming the anterior segment of the spine, as the particular objects of its invasion; to the exclusion of the pedicles, arches, transverse, oblique, and spinous processes, together with the ligaments and articulations, which form the posterior segment. That is, caries and ulceration commence in the anterior portion of the column, destroy it extensively from front to rear, and proceed both upward and downward; but they do not go backward, or cross the line of partition between it and the posterior portion. It may be deemed singular that, numerous as are the small joints formed by the opposing surfaces of the oblique processes, in the posterior segment, disease is scarcely ever witnessed in them. It will presently be seen that the structures of that segment have a remarkable disposition to take on reparative action, in antagonism, as it were, to the morbid action in front.

Disease of the spine occurs with equal frequency in the two sexes. It may commence at any period of life; but it is extremely rare past the middle term; it is most rife from early childhood to adolescence.

The disease is generally admitted to be one of the class called scrofulous; yet it is often met with in persons who do not otherwise show signs of that diathesis. Its origin is frequently attributed by the patient or friends to an accident, as a fall, that probably occurred a long time previously. But the evidence of the connection is seldom satisfactory. Greater importance is due to the unsound constitution which would cause such disproportionate effects to proceed from a slight injury.

Incipient stage of disease of the spine.[1]—The symptom which commonly attracts the notice of the friends of the patient first, and which is also the most important in the mind of the surgeon, is a prominence of one, two, or more spinous processes at some part of the column.

Unprofessional persons will speak of that projection as a "growing out" of the back. To the surgeon it is significant of a certain portion of the front of the spine having been destroyed by disease. He infers that an excavation there has caused the superior part to fall down at an angle to the inferior; and concludes that as the bend is directly forward, the loss of substance must be in the bodies of the vertebræ and intervertebral cartilages. The apex of the angle, it will likewise be perceived, will be formed by the spinous process of the vertebra in which the destruction has been greatest.

In the advanced stage of the disease, no symptom can be more easily detected than the prominence of the spinous processes; for the muscles in each trough will have become atrophied from want of use; and the ridge will stand out conspicuously like a keel, with rugged, serrated edge, each knob distinct; the transverse and oblique processes may even be well-marked. But in the recent stage, when the angle has just begun to appear, there are sources of obscurity, which sometimes make the diagnosis difficult. The protuberance can be more easily discerned in some of the regions of the spine than in others. It can be recognized in the dorsal before it can in the lumbar; and

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[[1] New York Med. Record, April 24, 1875.]

[[1] Sur la polyarthritis vertebrale; Broca, Gaz. Méd. de Par., 1879, pp. 454, 465.]

the reason is obvious. The natural curve in the dorsal region, has its convexity presenting backward; the ridge of spinous processes is, therefore, comparatively superficial; hence a trifling increase of the natural bend, caused by the destruction of even a small part of one of the bodies, will be distinctly apparent. But it is different in the lumbar region; the natural curve there has its convexity presenting forward, and owing to the hollow in the back, the tips of the spinous processes are situated comparatively deeply. When there is loss of substance, therefore, in the front or convex aspect of the curve, consequent on carious ulceration of the bodies and intervertebral cartilages, it may be long before the spine will fall forward, and bend in the reverse direction, so that the ridge of spinous processes shall form a convexity and visible projection posteriorly. Moreover, from the great depth and magnitude of the lumbar vertebræ, it is obvious that the destruction of their substance must be proportionally extensive, for the column to be bent at an angle. In the cervical region, the normal curve is similar in direction to that in the lumbar. When the disease, however, attacks the vertebræ there, the effects differ from what are observed elsewhere; the portion of spine above the carious ulceration does not fall forward; the weight of the head overcomes that tendency; and the result is that the head subsides vertically, so as to approximate to the upper part of the chest, and obliterate the appearance of the neck. Accordingly, the occiput comes in the way of an examination, preventing the tips of the spinous processes from being felt by the fingers.

But in reference to these normal curves of the spine, it is to be remembered that they are not properly established till about puberty; and that up to that age, the column is very flexible. A difficulty of diagnosis is, therefore, sometimes found in young patients, as a consequence of this suppleness; especially if they have been previously debilitated by illness. When a weakly child sits, he usually stoops; and if the spine be examined, the ridge of spinous processes will probably project conspicuously and alarm the parents; it is not unlikely, moreover, that the chief protuberance will be about the middle of the lumbar region, where a hollow might be expected in the adult. If it should be apprehended that disease of the spine was commencing, the point of greatest interest would be to observe whether there were any distinctly abrupt projection of one particular spinous process, to mark it as the apex of an angle, however obtuse. Should doubt still remain, the child may be laid on its belly, and the hips elevated to a higher level than the spine; if the structures be sound all appearance of the abnormal protuberance will then be removed; if, on the contrary, the projection be consequent on disease, it will continue to be perceived.

Rigidity of the affected portion.—For the detection of disease in the spine at an early period, no symptom is more valuable than diminution of the natural flexibility of the column at the suspected part. And the reason why that defect should indicate disease at its incipient stage, may be stated. Pathology teaches that as soon as caries and ulceration attack the bodies of the vertebræ and intervertebral substances, adhesive inflammation is set up in the adjoining structures, more particularly in the posterior segment of the spine. Coagulable lymph is thrown out in the interstices of the laminæ, joints, and processes situated at the back; and as the lymph solidifies the vertebræ become agglutinated and deprived of their natural mobility. Parallel instances are met with in diseases of the joints elsewhere: for example, an early symptom in hip-disease is interruption of the free motion of the articulation. The rigidity of the spine may be made evident by the simple expedient of directing the patient to stoop forward, and rise alternately; or to incline his body first to one and then to the other side; if the column be carefully watched during these movements, and caries has commenced, a distinct contrast will be perceived between the natural flexibility of the spine throughout its principal extent, and an abnormal inflexibility in the portion occupied by about four or five adjoining vertebræ. The latter bones will appear to be moved as a united, compact mass. Or if the palm of the hand be planted broadly and flatly over the vertebræ suspected to be diseased, including some of the sound adjoining parts, and if the patient be asked to stoop and rise as before, a distinct sense of movement among the various processes will be communicated to the fingers at the sound part, while there will be an absence of such a feeling at the diseased part.[1]

Heat and swelling.—When the disease is acute and the ulceration in active progress, both these symptoms will be present. The increase of temperature may be ascertained by the touch, but it will be certified better by the thermometer. The swelling is seldom such as to be prominent and distinct; it consists rather in a general fulness which partially obscures the forms of the bones. When considerable, it indicates an actively progressing condition of the caries. When absent, and the points and surfaces of the bones are visible and defined, it furnishes an argument for supposing that the disease is dormant and that ankylosis may have taken place.

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[1] [Physiological curves of the vertebral column; Balandin, Virchow's Archiv, June 10, 1873.]

Pain.—This, which is a faithful guardian in general of the textures of the frame, is a fallacious monitor in regard to disease of the spine. It fails to warn when danger is imminent, and it alarms needlessly. As a proof that carious ulceration of the vertebræ is not always attended with pain, it may be stated that numerous patients have gone through the whole course of the disease, so as to have angular deformity of the worst description, without having been confined to bed a week or day, from inability to go about. Again, other patients, almost always females, have suffered sharp pain in a part of the spine, from supposed disease, while every vertebra was perfectly sound. Nevertheless, in acute cases of real disease of the spine, pain in the affected part of the back is a leading symptom. It will be varied sometimes by the feeling of painful constriction about the epigastrium, as if a cord were tied round the waist. The act of raising the patient, or turning him round in bed, will cause great agony. If his limbs be affected with convulsive startings the shock communicated to the spine will be attended with much pain. His nights will be sleepless. Such attacks do not commonly last long, but they are apt to recur; they indicate accessions of the acute morbid action.

In a large proportion of cases, pain is a subordinate symptom; and some devices are necessary to make it be felt. While the patient is upright, a shock may be given to the spine, by placing the hands on both his shoulders, and suddenly depressing them; the jerk will probably cause pain in the affected part. Or he may be asked to jump from a low stool upon the floor. Percussing each spinous process in succession is another mode. The plan of carrying a hot sponge down the spine, in the expectation of the warmth bringing out the pain, has not much to recommend it. When dull aching pain, always returning to the same part of the spine, follows exercise, jolting in a carriage, or sitting for a long time, it betokens latent disease.

Neuralgia of the spine.—It is necessary, for assisting diagnosis, to notice here a kind of pain which fixes itself in some particular spot of the spine, and is liable to be mistaken for a symptom of organic lesion. It differs from those pains in the back which can be traced directly to rheumatism, dyspepsia, diseases of the kidneys, or of the uterus, or ovaries. The affection is nervous and functional. It may be considered to have the same relation to the spine which clavus hystericus has to the head. Pains resembling it visit different parts of the body; but they have one common character in affecting females prone to hysteria almost exclusively. Sir B. C. Brodie gave to them the name "hysterical neuralgia." They are not uncommon in the joints generally, particularly the knee. When that articulation is affected, the pain may be of long duration, exhausting to the constitution. It has fallen to the lot of the writer to have witnessed two cases of that hysterical neuralgia of the knee-joint, in both of which the patients, young females, consented to lose their limbs on account of the severity of the pain. They were under the care of the same surgeon, who conceived that their sufferings were owing to acute ulceration of the cartilages of the joints, requiring amputation; and chloroform had not then been introduced. In both cases, the cartilages and all the other structures of the joints were found, after the operation, to be perfectly healthy. The lesson taught by these examples, and enforced by other considerations, is that, when the spine is affected with similar pains, they may be acute and long persistent, without boding actual disease.[1]

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[1] The subsequent history of one of these patients was not a little remarkable. Although the stump was apparently sound, it soon became the seat of pain, equal to what had been felt in the knee. Thereupon the surgeon repeated the amputation higher up. Healthy cicatrization took place; but ere long pain, as bad as at first, returned in the new stump. The next proceeding was to excise a large portion of the sacro-sciatic nerve. But this operation had no better result than the preceding. Neither surgeon nor patient, however, lost heart. As there still remained a portion of limb capable of removal, amputation at the hip-joint was performed. The large wound healed favorably. Yet the pain did not depart; it continued in the cicatrix as great as ever, and of the same kind as at first. The young woman was eventually sent to the sea-side. There she became pregnant. Upon her return it was ascertained that as soon as she felt herself in the family-way, the neuralgia ceased. Having subsequently become the mother of a large family, she has been frequently seen on account of her children; and, according to her statement, she has still occasional attacks of the old pain in the stump.

The writer has been informed of a similar case which occurred recently. The surgeon was induced, chiefly by the solicitations of the patient, a woman of hysterical temperament, to amputate her limb for supposed ulceration of the cartilages of the knee-joint. The structures were found healthy.

Every part of the spinal column would seem equally prone to be affected with this neuralgia. Perhaps it may be met with more frequently at the site of the "vertebra prominens," than elsewhere; and when seated there, the protuberance of the spinous process increases the fear that disease may be its origin. A peculiar feature of the pain is that it is circumscribed within a small area, so that the part might be covered with the point of the finger; and the description often given is that it resembles what might be produced by a nail being driven into the side of the spine. The actual suffering to which the pain gives rise is undoubtedly great; but the effect on the patient's mind is not the least of the evil consequences. She becomes the victim of unfounded apprehensions as to the nature of her complaint—being commonly possessed with a conviction that a frightful corroding ulcer, of some kind, is destroying her spine. Forthwith she is furnished with an invalid bed; and months or years may elapse before she rises from it.

The main points which deserve attention, in forming a diagnosis, are: 1, that no appreciable angular deformity exists; 2, that there is no perceptible rigidity in the affected part; 3, that while undergoing the examination, the patient will wince and jerk the body, each time the spine is touched; which is contrary to what she would do if the pain depended on disease; lastly, in reference to those cases in which the pain in the back has lasted over many months, and the lady has been confined all the while to her couch, and yet no deformity is apparent—which is the history of almost all these neuralgic cases—it may be argued that, if caries had been engaged, all the while the pain was felt, in destroying the vertebræ, deformity of an unmistakable kind would have been produced.

It is not uncommon for hysterical patients, especially those who have been long confined to the recumbent position, to lose control over their lower extremities, to have "hysterical paraplegia." When neuralgia of the spine is added, the complication no doubt increases the difficulty of diagnosis. It will, however, be perceived further on, that when paraplegia occurs as the result of carious ulceration, it is preceded by strikingly marked angular deformity of the column; a condition that does not belong to neuralgia. Yet, in certain rare cases, deformity may not be wanting to increase the perplexity.[1]

The writer had under his charge a governess, twenty-two years of age, affected with paraplegia; she suffered at the same time from neuralgia in the spine. On examining the seat of the pain, which was in the lumbar region, a projection of some of the vertebræ was distinctly visible. The patient had been obliged to relinquish her situation in a family, as it had been stated by the medical attendant that she had spinal disease, accompanied with affection of the spinal cord. From inquiry, however, into the history of the deformity, and examination of the whole spine, it was made out satisfactorily that the bulging of the spine at the loins was a consequence merely of lateral distortion; that the pain situated there was nervous; and that the dragging of the limbs and inability to walk were symptoms of hysterical paraplegia. Under treatment by physical exercises, shampooing, shower-baths, tonics, etc., she perfectly recovered in a few weeks.[1]

Angular Deformity.

When the substance of one or more bodies of the vertebræ has been removed by caries, it may easily be understood that, from the superimposed portion having been undermined, it will fall forward and form an angle with that below. The pressure of the superincumbent weight, however, is not the only agent in producing the bend; when a patient is confined strictly to the recumbent position, the angle continues to become more acute, which shows that the action of the abdominal muscles shares in causing the deformity.

Fig. 683, copied from a photograph, shows the appearances commonly presented in a case of angular deformity from spinal disease. The patient, a delicate girl, fourteen years of age, had become deformed to the extent seen in the drawing, shortly before her admission into the hospital. She had been generally able to go about and attend school during the progress of the deformity. Latterly, she failed in her power of walking. But it was ascertained by frequent observation that this defect did not proceed from paraplegia, but only from inability to balance herself in the newly-deformed

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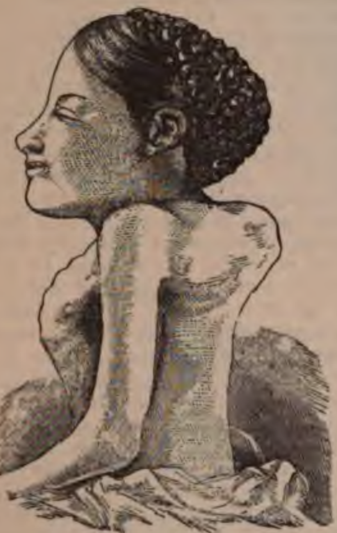
[[1] Vidal, Painful points of the spine in affections not spinal; Progrès Med., 1879, No. 28; Skey, Hysteria; Paget, Clinical Lectures and Essays; Shaffer, Hysterical Element in Orthop. Surgery, New York; Johnson, Backache, Brit. Med. Journ., Feb. 12, 1881; Gibney, Spinal Irritation in Children, New York, 1879; Coghill, Spinal Irritation an Idiopathic Affection, Brit. Med. Journ., 1879, Oct. 11, p. 571; Elliott, Dublin Journal Med. Sci., Nov., 1880, p. 369.]

[1] See article HYSTERIA, Vol. I., p. 588. Lectures on the Local Nervous Affections, by Sir B. C. Brodie. Also a masterly essay On the Moral Constitution in Females of Hysterical Diathesis, by Dr. Robert Fergusson, prefixed to Dr. Gooch's Works, published by the New Sydenham Society.

condition of the upper region of her body. She became strong on her limbs after a short stay in the hospital.

Fig. 683.

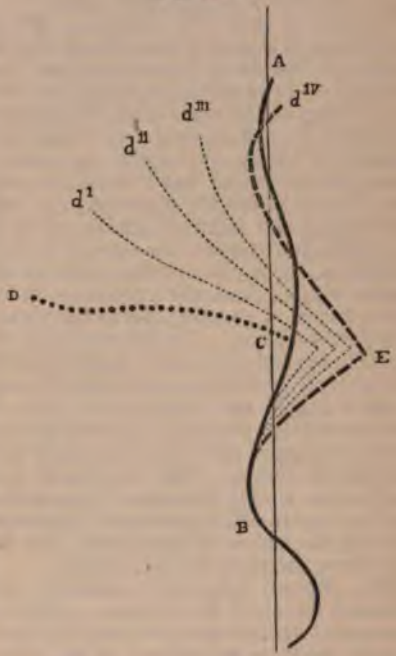


From the bodies and fibro-cartilages in which the loss of substance takes place, being in the median line, the descent of the upper portion is generally in a direction straight forward. That, at least, is invariably the case in the dorsal region. But in the dorso-lumbar and lumbar regions, at which greater latitude of motion exists, a lateral deviation will sometimes be combined with the movement forward. The surgeon may be deceived by that inclination to one side; and commit the dangerous error of supposing a case of angular deformity to be one of lateral distortion.

The writer was consulted about a girl, aged fifteen, who had a projection at the dorso-lumbar region, with a distinctly marked deviation of the spine to one side, simulating closely lateral curvature. The medical attendant had considered the case to be of that kind, and put the patient on a course of calisthenic exercise. It was distinctly ascertained, however, that the prominence was the effect of caries; and the principal diagnostic sign was the directness with which the spinous processes stood out backwardly, against the skin; for it is a never-failing observation in regard to lateral distortion, that, owing to the rotation of the column on its long axis, which always accompanies incurvation, the spinous processes are pointed laterally toward the concavity, and that to such a degree that they are nearly hidden from view by the overlapping of the edge of the longissimus dorsi.

But angular deformity does not consist merely in a falling forward of the undermined portion of the spine, while the inferior remains erect. It is not the same as when a rigid pole, like a flagstaff, is broken by the wind, and the upper part falls over. Were that the case, a patient in whom the spine had become bent would not be able to preserve his equilibrium; his head would be thrown inordinately in front of the line of gravity, and if he attempted to walk, he would be precipitated forward. When a person, therefore, has spinal disease, yet is able to be upon his legs, he is instinctively led to make certain efforts for restoring the balance; the nature of which the accompanying diagram is intended to illustrate. In his first endeavors, he grasps both thighs above the knees with his hands, thus making supports of his arms; he tries at the same time both to elevate the head, and to carry the upper part of the body back, obviously with the design of bringing them more directly into the centre of gravity. Eventually he succeeds; and it is obviously by causing the portions of the column above and below the angle to arch backward. But these incurvations will have the effect of carrying the angle itself also backward. Hence

Fig. 684.



A, B. Spine in profile. C. Seat of disease. C, D. Upper portion fallen forward, di, dii, diii, div, upper portion both elevated and carried back to the line of the centre of gravity. E. Apex of angle moved back.

the prominent "hump," which is such conspicuous feature in the deformity from spinal disease, is produced. It may also be perceived that the apparently proud air with which the patient carries himself—his face turned upward and his body thrown back—is merely an effect of his continued efforts to restore the head to its proper vertical position above the base of the spine. When the disease is in the lumbar vertebræ, and a deep chasm is formed just at the base, the column falls down in its whole length; there are therefore no means of transporting the angle backward in the manner described above; and the patient is in the pitiable condition of being obliged to carry his body horizontally, *ventre a terre*, progressing on his knees, or feet, and hands.[1]

Changes in chest and abdomen.—When the disease is seated in the dorsal region the whole thorax is included in the deformity, and the abdomen partially; the trunk being at the same time diminished in height, as well as rendered broad and square, without distinction of waist. Owing to the falling forward of the portion of spine above the diseased part, the antero-posterior diameter of the chest is increased in length; the sternum also protrudes, being sometimes bent at an obtuse angle; and the projection there forms a kind of counterpoise to the posterior protuberance. The viscera both of the thorax and abdomen accommodate themselves, by alterations in their forms, to the changed condition of the walls of their respective cavities, neither their internal structure nor their functions appearing to suffer. The œsophagus and trachea are simply shortened; the aorta, having to give off its intercostal branches, follows the course of the spine, and is, therefore, about its natural length.

The disease sometimes attacks two different parts of the column, either at once, or at distinct periods; thereby causing two angular projections of the spine in the same patient. In the last case witnessed by the writer, the boy had just recovered from disease in the dorso-lumbar region, when it appeared in the cervico-dorsal vertebræ; there it extended to the spinal cord, and the patient died in a few months with paraplegia.

Spinal Abscess.

The importance of the subject of abscesses connected with disease of the spine, may be judged of when it is stated that they are the most frequent causes of death in this complaint. Yet happily in a large number of cases the disease runs its whole course, producing extreme deformity and ending in ankylosis, without evidence of any abscess having formed.

It has been shown above that the destructive effects of spinal disease are confined to the anterior segment of the column; and that while the morbid processes are committing extensive ravages there, an opposite reparative or defensive action is going on in the posterior segment. Now, the different courses followed by spinal abscesses cannot be properly understood unless the influence of these distinct agencies be kept in view.

And here a remark concerning the constitution of abscesses generally may not be out of place. It belongs to all abscesses to have an element of self-cure as well as of increase. In the walls of a simple abscess two different processes are observed to be going on. The deeply-seated part of the parietes carries on a formative action, opposed in its nature to an absorptive one in the more superficial part. And it is by the concurrent growth at the bottom or basis, and removal and thinning of the structures toward the point of acumination, that the contents are eventually brought to the surface and discharged. On the pus being evacuated the cavity is filled up by granulations springing from the under surface, on the same principle as a wound is healed by the second intention. When the abscess is cured by resolution, it is from the adhesive, formative, or reparative process overcoming the suppurative and absorptive. The pus is then taken up and carried into the system; the walls proportionately thicken by new growth till they close in and obliterate the cavity.

The mode in which an abscess is first formed, in disease of the spine, appears to be as follows: The morbid process being a species of ulceration, the act of removal of substance is accompanied with suppuration. In an ordinary ulcer, say of the skin or mucous membrane, the pus thus discharged is either collected under the dressings or washed away. But in the spine the matter is caught by the connecting tissue; that becomes thickened and condensed; and at length an abscess, with proper pyogenic membrane, is constructed. When a collection of pus is thus formed, various causes may lead to its progressive increase. From the denudation of the bone and fibro-cartilages, and the exposure of their surfaces to the pus, the ulceration may be expected to spread. Owing to the natural flexibility of the spine the attrition between the opposing diseased surfaces will be great; but it will be made worse by the additional mobility consequent on the destruction of the fibro-cartilages and other ligaments which con-

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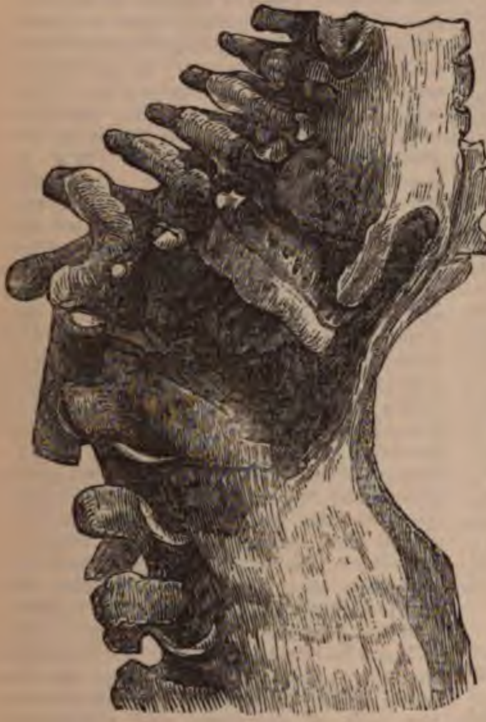
[1 Disease of spine without angular deformity, Br. Med. Journ., April 24, 1880, p. 627.]

nect the vertebræ. Again, in proportion as the excavation proceeds, and the spine becomes more bent, all the adjacent structures in front of the column will become further relaxed, and so facilitate the accumulation of pus in the abscess.

The patient from whom the specimen represented in fig. 685 was removed, was a blacksmith, twenty-eight years of age, and was admitted into the hospital for a psoas abscess, about the size of a large orange, situated in the left groin. He had an abrupt angular deformity in the back, with protuberance of the sternum; and his muscles, particularly those of the upper extremities, were largely developed. The deformity had taken place when he was fourteen years of age; and it had not increased since. His father being a blacksmith, he had been early put to the same work, and had continued uninterruptedly at it till three weeks before his admission, when he first noticed the swelling in the groin. On the abscess being tapped, a straw-colored fluid was discharged; the opening did not heal; ordinary pus continued to flow; and he died exhausted with hectic fever. It will be remarked in the figure that the posterior arches and articular processes of the vertebræ, at the seat of disease, have been firmly united together by bone.

Fig. 685.



Yet experience shows, as already remarked, that in a large number of cases the disease proceeds to the effect of producing extreme deformity, even combined with paraplegia, without any signs of abscess presenting themselves. But it is not to be concluded on that account that abscess has not existed in these cases. Owing to the inaccessible situation of the diseased parts, a collection of matter may have formed in connection with the carious vertebræ, and its presence would not be known if it remained of small size. An abscess, therefore, arrested in its progress before becoming sufficiently large to show itself outwardly, might have been lodged for an indefinite length of time in the angle of the diseased bones, and been eventually removed by resolution, without its existence having been suspected.

Let it therefore be asked, under what conditions it may be expected that an abscess in course of formation, in contact with diseased vertebræ and fibro-cartilages, may be arrested in its progress and dispersed? That inquiry introduces the subject of ankylosis.

Ankylosis.—When inflammation of the adhesive type affects a bone, the first change observed is a thickening of the periosteum, extending more or less to the connecting tissue around; by that means the adjoining structures are agglutinated and a bed prepared for the deposit of ossific matter. As stated before (*supra*, p. 302), one of the consequences of caries attacking the bodies of the vertebræ is, that adhesive inflammation is set up in the posterior segments of the bones. It may therefore be assumed that shortly after the commencement of the disease, the connecting tissue in the interstices of the vertebræ behind, will be consolidated, and by taking on the office of additional ligaments, will bind the arches and different processes together. The immediate effect of this cohesion of several vertebræ will be, to diminish, if not altogether stop, the jarring and friction between the diseased surfaces, which tend so greatly to aggravate the morbid action. An incipient abscess will, therefore, be in a comparatively more favorable condition for undergoing cure by resolution. Accordingly, it may be supposed that the diseased process will sooner or later cease; that the abscess will be obliterated; and that the confronting surfaces of the partially destroyed vertebræ will come into apposition. The consolidated posterior segment will preserve the vertebræ at rest, like splints applied to a fractured bone; the surfaces may therefore be expected to unite; with, perhaps, remnants of the bodies of several adjoining vertebræ all fused into one. Such is a description of *true* ankylosis.

Spurious ankylosis.—This term is applied in reference to the joints in general, to that kind of union between the surfaces, after disease, in which the bond consists either wholly of fibrous structure, or of that combined with osseous matter. In the spine it denotes that the posterior surfaces of the vertebræ alone, including the laminæ and various processes, are soldered by bone, while the surfaces of the bodies, partially consumed by the caries, are apart; and are connected above and below by the remains only of the walls of the obliterated abscess.

The writer had an opportunity of exhibiting, at a meeting of the Pathological Society,[1] a series of five different specimens of vertebræ united by bone after caries, and in which the ankylosis was partial. The appearances were essentially the same in all. Down the whole length of the posterior segments of the affected vertebræ, perfectly solid ossific union could be traced between the margins of the laminæ and the oblique processes, including their articular surfaces; and it was so firm and general, that all mobility was destroyed. But no similar union had taken place on the fore part. The bodies had been destroyed to different degrees, and gaps of various width separated them; so that the continuity of the spine as a column, depended wholly at the diseased part on the posterior segment. The amount of separation between the surfaces of the bodies was owing to two distinct causes; in some of the specimens, the distance at which the surfaces were apart was to be accounted for principally by the quantity of substance lost through the carious ulceration; in others, it was obviously consequent mainly on the too great obtuseness of the angle at the seat of flexion, and the inability of the surfaces, from the spine having become fixed, to approach closer to each other.

The importance, in a practical view, of keeping this distinction between the two forms of ankylosis in mind is obvious.

1. It bears on the question, as to which position of the spine, during the treatment, is most favorable for obtaining solid union between the surfaces at the close of the disease. The friends of a young patient are naturally much distressed when they see the rapidity with which the spine becomes bent, and they would fain induce the surgeon to employ measures to keep the column straight. They are not aware that a certain amount of deformity is a necessary condition of cure in this dangerous disease. Loss of substance in the fore part of the column is inevitable: the destroyed portion cannot be replaced: the only way by which a cure can be effected, is by the upper and lower portions coming into apposition, and uniting as a broken bone would do; but that approximation and union can only take place by the spine becoming bent at an angle more or less acute. Hence, even if the treatment by extension were safe—which it is not—a sufficient argument against it would be, that in the event of its being carried out, the only union obtained would be in the posterior segment, and a permanent gap would be left in front.

2. It is sometimes advantageous for the surgeon to be acquainted with the proceedings of quacks. Bone-setters and others frequently undertake to straighten the spine in cases of angular deformity; and as they occasionally have a certain temporary success which gains them reputation, it is more necessary to understand what they do, and at what a risk. They will take, for example, a young man who has a prominent hump in the dorsal region, consequent on disease which he may have had in childhood. By confining him in the recumbent position, employing mechanical means to stretch the back, and putting him on physical exercises, not forgetting to manipulate the projecting vertebræ sufficiently often, the spine may be made straighter, and the hump less distinct.[1] The quack will probably represent that the cure has been effected by his reducing the dislocated bones at the angular projection. But it is obvious that the apparent improvement has been brought about wholly by the extension of the sound portions of the spine above and below the apex of the angle. Each of these portions, besides being inclined from before backward, is curved; and it can be easily understood that, by restoring them to a vertical line, the whole column will be rendered straighter, and the protuberance less distinct. But it is not to be expected that the improvement will last. As no change can be made in the relations of the vertebræ at the seat of ankylosis, and their surfaces, in conformity with the angle they form, are placed obliquely, the longitudinal axis of the upper and lower portions respectively must likewise be bent in reference to each other. Hence the spine will soon return to its former condition. But it is the danger of the treatment which constitutes the chief objection. And that arises from its being impossible to know beforehand what is

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[1] Path. Trans., vol. i., p. 328.

[1] See a series of casts taken from patients who had undergone treatment by mechanical extension for angular deformity, contained in the Museum of the Middlesex Hospital.

the exact kind and degree of union that may have taken place at the seat of disease, or what may be the state of the abscess. If the cavity of the abscess has been obliterated, and the former communication between it and the carious bodies closed, and if the ankylosis has been perfect, so that no remnant of the disease has been left, the treatment, however rough, might do no harm, if it did no good. But the results would be disastrous, if the ankylosis were spurious, and the walls of the abscess were the only connection between the upper and lower portions in front. Owing to the union between the vertebræ at the back, the mobility would be destroyed, and it might be inferred that the ankylosis was perfect; yet the osseous bond might not be sufficiently strong to resist the violence sometimes employed in endeavoring to straighten the spine, by ignorant practitioners.

A friend related to the writer the following case, and also showed him the preparation connected with it. A young woman had caries of the lower cervical and upper dorsal vertebræ, from which she recovered, so as to be able to resume her employment. The angular deformity being considerable, she applied to a quack, who promised to make the spine straight. The treatment consisted chiefly in employing mechanical means to stretch the neck. While increasing the power one day, there was an audible snap, with sudden pain. The patient was found immediately afterwards paralyzed from the neck downwards, and in a few days she died. It was found at the post-mortem examination that there was an abscess, nearly obliterated, in front of carious vertebræ; and that the walls of the abscess had been extensively torn from their connections with the bones. The spinal cord was diffluent near the seat of injury. It cannot be doubted that when the force of extension was increased and the snap heard, the bony connections of the posterior segment of the vertebræ had been broken, the walls of the abscess detached from the bodies in front, and the spinal cord ruptured.

Psoas and Lumbar Abscess.

The abscesses hitherto treated of have been supposed to have stopped growing before they attained a large size; they have remained dormant, or been removed by absorption. The next to be considered are those which have progressively enlarged, and travelled long distances to evacuate their contents externally. Owing to the great dimensions which the latter commonly acquire, and to their cavities communicating with the vertebræ while still in a state of disease; they are especially dangerous in their consequences; they are, indeed, the most frequent causes of death in spine disease.

A spinal abscess, at its commencement, lies upon the carious vertebræ, filling up the angle in front. It is favored in taking that position by the bend in the column, which has the effect of relaxing the structures on the fore part, and facilitating the accumulation of fluid. For the same reason abscesses will sometimes increase to a large size in the dorsal region without producing undue pressure on the roots of the lungs. As the pus accumulates, it is prevented by the portion of spine which forms the upper side of the angle overhanging it, from ascending; it cannot proceed backward, owing to the thickness of the structures;[1] it would be difficult for it to make its way down the front of the bodies; accordingly, the ordinary course which an abscess takes when it enlarges is downward, by the sides of the bodies of the vertebræ. Sometimes the main sac bifurcates, one branch descending along the right and the other along the left side. In the thorax, the walls of the abscess are covered in front by the costal pleura; in the abdominal region by the parietal peritoneum. When the abscess is connected with diseased dorsal vertebræ, it encounters in its descent the diaphragm. But that barrier is overcome by a particular process. As the abscess comes into contact with the diaphragm and compresses it, adhesive inflammation is set up in their respective surfaces; the consequence is, that they become united over a considerable area; an opening is next formed by absorption within the boundaries of the adhering structures; the abscess then protrudes; and extravasation of pus at the margins is prevented from taking place by the firm union of the parts encircling the opening.

Psoas abscess.—When the abscess has thus perforated the diaphragm and gained its abdominal side, it comes into relation with the heads of the psoas muscle. That muscle arises by one set of fibres from the sides of the bodies of the vertebræ, by another from the roots of the transverse processes; and stretched across both origins in front are the ligamenta arcuata. As the abscess, therefore, travels downwards, it has to pass through a narrow strait; it is prevented from enlarging on the fore part by the resistance of the ligamenta arcuata, and at the back by that of the spine and lowest rib; hence, in order to proceed, it has to force its way in the line of the psoas muscle. That, however, can only be done by penetrating into its interior. It accomplishes this, in the first place, by inserting its most advanced part, like a wedge, between the two origins; it then splits and distends the fibres, so as to form a cavity for the reception of the pus; the muscular fibres become incorporated with the walls of the abscess; and the psoas at length is converted, more or less thoroughly, into an abscess. But the muscle charged with pus does not expand equally in every direction. The fascia iliaca forms a kind of sheath for it; and this, being particularly strong on the inner side and united firmly to the brim of the true pelvis, prevents the growth of the abscess inwardly. On the outer side, however, the connections are loose; and there enlargement takes place freely. The abscess now chiefly occupies the hollow between the united fibres of the iliacus internus and psoas muscles, on the inside, and the crest of the ilium on the outside. When the advanced part reaches the level of Poupart's ligament, a certain retardation occurs; and then a bulging will be observed along the line of the flexure of the groin. The abscess now perforates the abdominal walls in the same way as it formerly did the diaphragm. And the opening is invariably at one place, namely, behind Poupart's ligament, between the united tendons of the iliacus internus and psoas muscles, and the anterior inferior spinous process of the ilium. The situation corresponds to the point of junction of the outer with the middle third of Poupart's ligament.

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[1] The writer does not remember more than one case in which a spinal abscess in the dorsal region opened directly backward. There were two orifices near the projecting angle. The pus flowing from them had bubbles of air mixed with it; and it was noticed that these were drawn within the openings in inspiration and expelled in expiration.

Before the protrusion takes place, there will be a certain amount of thickening and condensation of the connecting tissue in the groin—a consequence of the inflammation excited by the near approach of the abscess—and a provision at the same time for strengthening its walls when it does emerge. On the abscess actually escaping, it will be suddenly relieved from a considerable compression to which it had been subjected in the interior; and it is from that cause, probably, that it increases rapidly in size as soon as it appears outwardly. The enlargement is sometimes greatest in the groin, and for a short way down. But it is more common for the abscess to descend for some distance on the thigh; and the direction then varies. Owing to the walls abutting at the commencement of its course against the origins of the sartorius and tensor vaginæ femoris, and their opposing its progress outwardly, the line which it most frequently takes is inward and downward, along the sartorius; and it often accompanies that muscle to near the knee. Sometimes, however, soon after its appearance in the groin, it turns sharply inward to occupy a space over the adductor muscles. In a comparatively rare set of cases it bends outwardly. The least frequent direction is straight downward. Occasionally, the abscess divides at the groin; one portion going inwardly and the other outwardly.

"Neck" of the abscess.—It seems appropriate, on the analogy of hernia, to call the narrow part of the abscess where it passes through the abdominal parietes, its "neck." It may be true that, when an abscess has been formed in the thigh, consequent on matter descending from a diseased portion of the spine, it is free, like others arising differently, to secrete additional pus from its own pyogenic membrane, or to absorb it; yet it would appear that abscesses originally spinal, are mainly dependent on the parent one. Now, the channel of communication between the well from which the fluid is drawn, and the sac or reservoir below, is constricted at the neck more than elsewhere. It will depend, therefore, greatly on the width of that aperture as to whether the abscess in the thigh be abundantly or sparingly replenished from above. In general there is a disposition in the opening to contract: although it has never, according to the writer's knowledge, become entirely closed. The degree to which the narrowing has gone, will commonly be judged of pretty accurately by the feel of the parts when the contents of the abscess have been squeezed upwards, and then when uncompressed, and comparing them with the condition of the corresponding parts on the sound side. Occasionally both the neck and the channel leading from it to the abscess are constricted to such a degree that no traces of them can be found: the collection appears circumscribed; and a question arises as to whether it be really connected with the spine. The surgeon may, therefore, have recourse to another mode of examination; if he bandages the abscess firmly for a few days, it will be seen to have had the effect of reducing the swelling considerably in size; let him next leave the abscess without bandages, and permit the patient to be in the upright position; he will soon find that the swelling has returned to its original dimensions—thus showing that the channel was pervious, and that the pus could be passed along it, to and fro.

Lumbar abscess.—It was stated formerly, when describing the process by which a spinal abscess, originating in the dorsal region, made its way through the diaphragm, that the passage was effected through a narrow opening, bounded in front and outwardly by the ligamenta arcuata, behind by the lowest rib, and on the inside by the bodies of the vertebræ; and it was added, that the abscess continued its descent by penetrating the psoas muscle. At the point where this obstruction is met with, and where the ribs cease to form an obstacle to the passage of the abscess backward, it occasionally perforates the abdominal parietes, and presents itself in the loins as a "lumbar" abscess. In some cases the whole abscess takes that route, but in others only a part; so that the lumbar is merely an offshoot of a psoas abscess. Again, a lumbar abscess may be in connection with diseased upper lumbar vertebræ: just as may be the case with a psoas abscess. The lumbar abscess perforates the quadratus lumborum, and it appears under the skin on the outside of the sacro-lumbalis muscle. In its progress posteriorly the abscess meets with opposition from various dense fasciæ and tendinous expansions; which deflect its walls, and cause it to assume outwardly a broad and flat appearance, with slight elevation.

Spinal abscess in the neck.—Disease affecting the articulations between the two uppermost vertebræ of the neck, the atlas and axis, is characterized by certain peculiarities which entitle it to be treated of separately: its consideration will, therefore, be postponed to the end of the article. When any of the inferior cervical vertebræ are the subjects of caries, a collection of pus will form on their fore part, as in the spine generally: but instead of the matter accumulating there, and forming a prominent swelling which might compress the trachea or œsophagus, or dropping downwards, it is deflected laterally. Hence the abscess appears outwardly on one or both sides of the neck, inclining somewhat posteriorly.

Varieties in spinal abscesses.—It is proper to mention some exceptions or anomalies met with in abscesses in different parts of the spine.

1. In describing the first stage of the formation of psoas abscess, it was stated that the sac occasionally bifurcated; one branch descending along one side of the bodies of the vertebræ, and the other along the other. Cases in which both have arrived and pointed at the groin are extremely rare. Dissection sometimes reveals the fact, not ascertained during life, that while an abscess, on one side, ran its whole course and discharged its contents on the thigh, another, on the opposite side, stopped short about midway. In every case an examination ought to be made to ascertain whether there be two abscesses or only one.

2. It is not uncommon, in a case of psoas abscess, for the collection of pus to be arrested in its progress downward, just above Poupart's ligament, or when it is lying on the venter ilii. It may then increase in size and become a prominent, globular swelling, with distinctly defined boundaries.

A young girl, fourteeen years of age, had disease in two or more of the central dorsal vertebræ; it had caused great angular deformity, and, for a certain period, paraplegia; at length a globular swelling, visible to the eye, formed in the right iliac region. After remaining stationary for a short time, it began to diminish; then it got gradually smaller, till, after the lapse of several months, it had entirely disappeared, so that no trace of it could be found. The local treatment consisted in the continued application of the tincture of iodine. Eventually the patient's health was quite restored; the deformity alone remaining.

3. When a spinal abscess, in descending, reaches the hollow of the ilium, instead of pursuing its course downward, it occasionally turns sideways, mounts over the crest of the ilium, and discharges its contents, by one or more openings, over the glutei muscles. The same thing is sometimes met with in connection with lumbar abscess. The occurrence is more frequent in children than in adults: a difference which may be accounted for by the relatively small size of the pelvis in the former.

4. Sir B. C. Brodie has described certain cases in which part of the contents of a psoas abscess, when lying in the iliac region above Poupart's ligament, has made its way into the spermatic canal, and so appeared at the external abdominal ring, like an inguinal hernia.[1]

The writer has witnessed a similar case, in which the tumor had some resemblance to a reducible hernia. Along the flexure of the groin, and for some distance above, there was general fulness and induration of the structures. At the external abdominal ring, and for a short distance below, in the line of the spermatic cord, there was a circumscribed swelling, which became more prominent when the patient coughed. The contents of the supposed sac, however, were quite soft and compressible. The man was not aware that he had disease of the spine, having come to the hospital for some comparatively trivial complaint. On turning to the back, there was an absence of any distinct projection of the spinous processes; all that could be perceived was a slight arching backward of the vertebræ in the lumbar region, which was in contrast with the hollow naturally existing there. The chief diagnostic symptoms were, well-marked rigidity of the column at the loins, and natural flexibility elsewhere. Shortly after his admission he rapidly got worse; the abscess in the groin broke; and, on his death, the bodies of three lumbar vertebræ were found carious and surrounded by pus.[1]

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[1] On Diseases of the Joints, p. 267.

5. *Contents of spinal abscess discharged by the lungs.*—It has been already stated that when abscess forms behind the posterior mediastinum in connection with diseased dorsal vertebræ, it is generally prevented, by the bending and receding of the spine, as well as by the cavity emptying itself downwards, from enlarging to such a degree as to press on the roots of the lungs and impede their functions. But a danger of another kind is to be apprehended from the proximity of the collection of pus to the lungs: inflammation is apt to spread from the pleura costalis, which covers the walls of the abscess, to the pleura pulmonalis and substance of the lungs: pleurisy or pneumonia, or both combined, may then be excited, and death may ensue. A different result, however, may be looked for, in a few exceptional cases: namely, the evacuation of the abscess through the lungs. The process by which that is effected is the same that has been described in explaining how an abscess perforates the diaphragm in passing from the thoracic into the abdominal region. It is the same also as the process by which an abscess of the liver discharges its contents through the lungs. Firm adhesion is first established between the walls of the abscess and the surface of the lungs; next in some central part within the area of these adhering structures, an opening by absorption is made, having the margins secured by the surrounding adhesion; this opening brings the interior of the abscess into communication with lung substance, which becomes condensed in the neighborhood; a tunnelling is commenced through the latter until a large bronchial tube has been reached and opened; then the pus is coughed up and expectorated.

The writer was consulted in the case of a boy affected with angular deformity, the apex being formed by the spinous processes of the fourth and fifth dorsal vertebræ. He had been confined to bed at the commencement of the disease, five years before; he had since then been strong and active; and the object of the consultation was merely to ascertain whether anything could be done to improve his figure. During the interview the patient took from his pocket a small box containing fragments of bone: and these he said he had coughed up, together with a large quantity of matter, when his illness was at the worst. The structure of the pieces resembled that of the bodies of vertebræ; they were generally cancellous, but had here and there portions of cortical layers upon them; they were four in number, irregularly cube-shaped, the sides measuring, on an average, from three to four lines. It was supposed that they had lain loose in an abscess at the seat of the deformity, and been expectorated.

6. *Abscess opening into intestine.*—It is not uncommon for abscesses in the abdominal region, with whatever viscus they may be connected, to empty themselves into some part of the intestinal canal if they come into contact with it. For example, abscess of the liver frequently terminates in that way.

The following is a brief notice of a case in which a spinal abscess communicated with a portion of intestine, and in which not only did the matter of the abscess pass into the bowel, but the contents of the bowel discharged themselves by the abscess. The patient was a girl, thirteen years of age, who had acute angular deformity at the centre of the dorsal vertebræ, and a psoas abscess of several months' duration on the left side. The abscess reached down to the knee; the external opening being over the inner condyle of the femur. As a proof that the abscess admitted some of the contents of the intestines into its interior, the patient, during the writer's visit, picked from the orifice the skins of one or two peas, and a bit of undigested stalk of greens, which she had been lately eating.

7. *Spinal abscess discharging its contents by the urinary bladder.*—

An under-gardener, 24 years of age, had angular deformity; the most prominent spinous process being that of the seventh dorsal vertebra. He could not tell when the disease began; and as he had never missed a day's work on account of it, he had reluctantly left his situation to become a patient. By carrying the fingers deeply in the direction of the psoas muscle, a large abscess could be distinctly felt. He remained in the hospital two months, during which no perceptible change occurred. At the end of six months he returned, having worked at the spade the greater part of the intervening time. He stated that a week before, he had slight trouble in passing his water, and shortly afterwards he voided a large quantity of matter of a yellow color, along with the urine. That he had continued to do since; but latterly the proportion of the pus to the urine had gradually diminished. During his stay in the hospital, about a third of what was passed consisted of pus. No trace of the abscess in the iliac region, which had been repeatedly felt before, was discernible. The patient left the hospital of his own accord, a fortnight after his readmission; and he could not be heard of afterwards.

Diagnosis of spinal abscess.—One of the most frequent causes of uncertainty in distinguishing abscesses connected with caries of the vertebræ from other swellings in the same locality, is the insidiousness with which spinal disease, as already stated, often commences and proceeds.

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[1] See preparation in the Museum of the Middlesex Hospital.

The following is an example, being that of a psoas abscess mistaken for a hernia. The patient was a young man, son of a large farmer, fond of hunting, and he had regularly followed the hounds till a few days before coming to town for consultation. He had observed, for a week, in his left groin, a swelling which his medical attendant told him was a rupture, requiring a truss. In the flexure of the groin there was an oval tumor, of well-defined shape, and resembling a hernia, except in the point at which it emerged. It came out behind Poupart's ligament, an inch and a half externally to the part at which femoral hernia descends; in other words, it protruded at the place where psoas abscess appears when it passes out upon the thigh. Above the ligament, and in the iliac region generally, there were fulness and induration. On examining the back, no distinct protuberance of any of the spinous processes was visible. But in the loins there was a perceptibly greater bulging backward of all the vertebræ than is natural, without undue prominence of any individual bone; the lumbar vertebræ were likewise abnormally rigid; the only free mobility being in the dorso-lumbar region. The patient owned that, several months before, he had received an injury in the lower part of his back; but it was so slight that he had not given up any of his active pursuits for it. The dangerous nature of his illness was explained to him. He was loth, however, to forego his hunting. Ere long the abscess enlarged, broke, and discharged a large quantity of pus. When last heard of, his recovery was deemed hopeless.

An abscess originating in caries of the lower lumbar vertebræ and extending it may be to the sacrum, is liable to spread laterally on the wing of the ilium, and to rise above the level of the crest. A swelling of that kind, if it be on the right, may be confounded with a cæcal abscess. Or if it surmount the crest and discharge its contents backward and downward, the movements of the hip will be disturbed; and it will be supposed to have originated in morbus coxæ. The diagnostic symptom most to be relied on in these doubtful cases, is the degree of flexibility observable in the lumbar region.

A tumor of medullary cancer is not unfrequently mistaken, according to its situation, for either a lumbar or psoas abscess. The uncertainty will be increased if the cancer has invaded the spine, and by converting part of it into its own morbid structure, has caused the column to become bent. Again, it is the peculiar nature of this kind of carcinoma to throw out globular projections on the surface, resembling greatly the pointing of an abscess; moreover, the feeling of elastic resistance at the apices of these lobes, is so much like that of undulation of pus within an abscess, that a mistake in diagnosis is very apt to be made.[1]

The writer had lately under his care, in the hospital, a female of middle age, who had lateral curvature of the spine from girlhood; and in whom the hump was so prominent and abrupt that it might be mistaken for angular deformity from caries of the vertebræ. She was admitted for a tumor that occupied the inner side of the left wing of the pelvis, and was on a level, at its anterior part, with the crest of the ilium. An oval-shaped, projecting lobe, in course of time, formed on its most depending face, near Poupart's ligament; and the feeling communicated to the finger, when examining that part, bore the greatest resemblance to what is conveyed by pus, when near the surface of an abscess. The subsequent progress and termination of the case showed that the tumor was one of medullary cancer.

Treatment of external spinal abscesses.—In discussing the question of the two kinds of ankylosis of the spine, the true and false, reasons were advanced for believing that, when an abscess at the seat of disease subsided, to give place to ossific union, it was to the arrest of motion caused by the consolidation of the posterior segment of the spine that the beneficial effects were principally to be ascribed. In such cases, the abscess is confined within the range of the rigid portion of the column. But when unfavorable influences interfere with the termination in ankylosis, and the abscess enlarges by extension of its walls downward, it gets beyond the bounds of the inflexible part, takes its place in movable structures, and consequently loses the advantage which rest is calculated to confer. Thus progressive increase goes on, and the abscess eventually presents superficially, where, of course, exposure to the bad effects of motion is worse. These considerations enforce the propriety of employing, in the management of such abscesses, every available means for procuring perfect rest.

Another general observation applicable to the subject is, that in common with other collections of pus having their origin in diseased joint-structures or diseased bone, it is the continued irritation kept up in the walls of the abscess and adjacent parts, by the presence of the carious bones and ulcerated surfaces, which chiefly leads to the fresh formation of pus; whence all measures designed to forward amendment in the abscess, ought to be accompanied with others directed to improve the condition of the spine at the original seat of disease.

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[1] See article Cancer, Vol. I., p. 286.

An additional remark may be made, which still applies to large abscesses whether originating in the spine, hip, or other joints, when diseased. It relates to the contrast observed in the condition of the patient, before and after the evacuation of the contents: either when the abscess has burst spontaneously, or been opened by the lancet. It is constantly seen in practice that an abscess of extraordinary size will often remain for many weeks together perfectly quiescent; perhaps enlarging a little at one time, and diminishing a little at another; the patient being all the while free from constitutional disturbance. But if the abscess point and break, or the surgeon open it, and the puncture does not heal, but the matter continues to run, an important change will soon occur. The unfavorable symptoms come on at various periods in different cases. It may be expected that within a few days the quantity of pus from the abscess will greatly increase: that it will become thin, and perhaps variously discolored. At the same time also, the patient will sicken, his pulse will be quickened, his skin hot, with occasional profuse perspirations; the fever will be hectic, attended with gradual wasting and increasing debility; the liver will probably enlarge by fatty degeneration; and he will die exhausted by the combined effects of the purulent discharge and the fever. (See article HECTIC, Vol. I., p. 126.)

Now it is the anticipation of that change being brought on by evacuating a lumbar or psoas abscess, that chiefly leads to hesitation and delay in the treatment. The surgeon may rest, for a while, on the hope that he may possibly succeed in dispersing the collection by resolution: he therefore keeps the patient rigorously at rest; supporting the strength by tonics and diet; and he applies assiduously tincture of iodine to the back, at the seat of disease; to the side, in the course of the abscess; and to the swelling itself; he thinks that if the abscess be not altogether removed by such means, its size will be diminished, and the walls converted into a fitter condition than before for the operation of puncturing. His expectations, however, will probably not be answered favorably. He may perceive that at some particular part there is an appearance of acumination, and he is desirous of averting spontaneous opening. Necessity, therefore, seems to compel him to adopt the plan of tapping the abscess and drawing off the pus. It may be supposed that the proceeding has been carried out in the most approved way, with all the precautions commonly urged (see article ABSCESS, Vol. I., p. 333); yet the almost inevitable termination will be, a bursting forth of the matter, from the temporarily closed openings artificially made, and an established discharge from the abscess, with all the uncontrollable ill-effects apprehended as the sequel. [König[1] claims that the successful treatment of lumbar and psoas abscess depends upon providing for perfect drainage; and for that reason it is desirable to have an opening in the lumbar region. For this purpose he makes a counter opening, when it is possible, in the back after incising the abscess, pointing in front.] These considerations prompt us to greet with welcome the valuable labors of Professor Lister, and of others, in their present active endeavors to improve this part of surgery.

[Gibney found that in 295 patients suffering from Pott's disease, paralysis occurred in 62 during the course of the affection. This complication is much more frequent when the disease is in the upper part of the canal than in the lower. Out of 189 cases of disease in the upper dorsal and cervical regions, paralysis occurred in 59; while only 3 were recorded with paralysis among 106 cases of caries in the lower portion of the spine.

Recovery from the paralysis appears to occur in the greater number of the cases. Dr. Gibney states that out of 58 cases with paralysis 13 died, 28 recovered from the palsy, 15 remained unrelieved at the time of the report. Some of the recoveries from the paralysis took place after the patients had been paralyzed four, five, and ten years, after symptoms of apparent myelitis.

Paralysis is rarely, if ever, an early symptom in caries of the spine. It is sometimes partial. In almost all the reported cases the paralysis was preceded by paresis.

In many there was an increase in the reflex irritability, and in some, muscular tremor or muscular spasm giving rise to rigidity of the limb.[2]

Paralysis is due to an extension of the inflammation of the bodies of the vertebræ to the dura mater of the cord, and the formation of a pachymeningitis; the cord becomes compressed, and a myelitis results from extension of the inflammation.

It seems incredible that recovery can take place after extensive degenerative changes have taken place, but such is undoubtedly the fact, as has been demonstrated by pathological evidence afforded by patients who have recovered from paralysis and subsequently died.[1]

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[1] Berl. Klin. Woch., Feb. 16, 1880.]

[2] Journal of Nervous and Mental Disease, April, 1878, p. 254.]

Probably paralysis also results in some cases directly from the pressure upon the cord by the contents of an abscess, which has extended to the dura mater but not yet occasioned a myelitis.[2] The symptoms diminish or disappear as the fluid escapes in another direction and the pressure is removed.

Echeverria claims that paralysis may also result from the thickening of the dura mater, without suppurative or inflammatory change in the cord proper. In some rare cases paralysis is caused by the pressure of a necrosed fragment of bone.

The myelitis which arises in Pott's disease is of course local, but ascending degeneration of the posterior median columns may occur secondarily, and also a descending change in the lateral, and occasionally in the anterior columns.[3]

Affection of the Spinal Cord from extension of the Disease.

When we consider the delicacy of structure and constitution of the medulla spinalis, and its contiguity to the centre of so destructive a morbid action as caries, we may be surprised that its functions are not lost in a greater number of cases than experience shows to be the fact. Yet, as the surgeon has no means of foretelling, in any particular patient, whether the cord will be affected or not, he is kept in constant apprehension.

Several circumstances combine to protect the cord from injury. First, in proportion as the spine falls forward, and forms an angle at the seat of disease, the abscess is propelled to the front, and the chasm between the bodies is closed behind, so as to prevent the pus from having access to the vertebral canal. Secondly, it is within the posterior segment of the spine that the cord is contained; and it has been formerly shown that, while the anterior segment, composed of the bodies, is the special seat of caries, the posterior is exempt from disease, and has a reparative or defensive action carried on within it: the cord, it may therefore be inferred, will not be injuriously affected by such kind of action. Thirdly, it might justly be feared that when a part of the spine had been destroyed by caries, and a deep gap formed between two or more of the bodies, the column would be so much weakened that it would be liable to be broken by any slight injury; and that the cord would therefore be crushed and deprived of its functions. But it has been already pointed out (supra, p. 307), that when caries attacks the vertebræ in front, a process of agglutination and consolidation, terminating in firm osseous union, is immediately set up in the posterior surfaces of the same bones. Hence, in proportion as the spine yields to the pressure of the superincumbent weight, and the upper part tends to fall forwards, that movement is restrained and moderated by the opposition of the structures behind, which have thus been endowed with increased strength. Accordingly the angle at the seat of disease is formed in a slow, gradual manner, without jarring or abruptness; and the cord becomes accommodated to its novel position without loss or impairment of its functions.

Before describing the morbid condition of the cord from which paraplegia ensues, it may be interesting to notice certain considerable changes in its structure which are connected with the deformity, but which do not involve any deprivation of its functions. When a large portion of the front of the spine has been removed by caries and the surfaces have united, not only will the characteristic angle be formed, but the column will be considerably diminished in length at the seat of disease. This shortening is to be attributed to the loss of substance which the affected vertebræ will have sustained, and to their having collapsed into a comparatively small size before union. The vertebral canal, and the cord contained in it, will necessarily participate in this bending and shortening, and be accommodated to both. Now it may be inferred that, to bring about the adaptation adverted to, a succession of minute interstitial changes in the substance of the cord must have been wrought during the progress of the deformity; that certain portions of the material will have been abstracted and their places not filled up; and that other portions will have been arranged in a different order from at first. It is not found, however, that either the atrophy, or novel arrangement of the nerve substance, has a prejudicial effect on the functions; for these will remain entire, however extreme the deformity. The explanation is founded on a well-known law in the pathology of the brain and cord; namely, that changes of extraordinary magnitude may be effected

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[[1] Michand, Meningitis and Myelitis. Paris, 1871.]

[[2] Gibney, loc. cit.]

[[3] Leyden, Rückenmarks-Krankheiten, 1874; Courjon, Étude sur la paraplégie dans le mal de Pott; Signez, Thèse de Paris, 1879; Paralysis Resulting from the Pressure of a Sequestrum, Soc. de Biol., Paris, May 22, 1880; Muscular Atrophy, in Revue Mensuelle de Méd., June, 1880; Duncan, Brain, 1880, iii., 48–56; Gowers, Lectures, London, 1879.]

in their structure by encroachments of various kinds, without the sacrifice of their functions, on condition that the intrusions are made slowly and gradually. Remarkable examples of the kind, connected with atlo-axial disease, will presently come before us (infra, p. 324). Moreover, every case of lateral curvature furnishes examples.

Disorganization of the cord; paraplegia.—From what has just been stated, it will be perceived that the change of structure in the cord which causes paralysis of the lower extremities, is not the mere alteration of its figure or size consequent on the angular deformity. It consists in a conversion of a portion of its substance into a new morbid tissue. A certain part of the organ, adjacent to the seat of caries, undergoes a process of breaking-down of its texture; the most conspicuous effect of which is a softening, approaching to liquefaction, of its columns and gray matter. If the diseased part be tapped with the finger, it will readily yield to the slightest pressure; if a stream of water be allowed to fall gently upon it, the soft substance will be washed away, leaving the connecting tissue. When the cream-like matter is examined with the microscope, it is observed to be made up of innumerable fragments of nerve-tubes, granules, oil-globules, and amylaceous cells, the débris of medullary tubes and ganglion-cells. A tinge of yellow pervades the softened and neighboring parts. The membranes do not commonly present any decided signs of having been implicated, nor is the vascularity much altered.

It will depend on the depth to which the morbid change reaches, in any particular case, as to the functions of the cord which will be abolished. We owe to modern discoveries the knowledge of the fact, that to the anterior column, from which the anterior roots of the spinal nerves arise, belongs the power of controlling the muscles; and that to the lateral column, from which the posterior roots arise, belongs sensation. Hence if the disease penetrate only so far as to destroy one column, leaving the other sound, we may anticipate that the function pertaining to the disorganized column will alone be lost.

Experience proves that, in paraplegia caused by disease of the spine, motor power is much more frequently destroyed than sensation; and so general is this fact, that it may be regarded as a comparatively rare thing for both motion and sensation to be lost simultaneously. As to the reverse kind—abolition of sensation with motor power remaining—it is doubtful whether such a variety was ever met with.

When we consider the relative position of the different columns of the cord to the centre of disease in the spine, we shall at once perceive why motion should be first destroyed. The anterior column, on which motor power depends, is separated from the bodies of the vertebræ only by the theca vertebralis and the other membranes of the cord: hence it may be expected that, when the morbid action proceeds backward, this column will be deprived of its function before any other. And its liability to be so involved will be increased by the compression to which it is peculiarly subject from the bending of the spine, as it forms an acute angle at the part.

Moreover, if we trace a filament of an anterior root to its origin, we shall find that, as it is about to join the cord, it subdivides into numerous minute radicles, and that these lose themselves almost imperceptibly on the *surface* of the anterior column. If, on the other hand, we take a filament of a posterior root, we shall observe that it continues as a single fibril up to the cord; that when arrived there, it dips bodily, without subdivision, into the fissure between the posterior and lateral columns; that while in the fissure, it pursues an unbroken course to the bottom; and that its actual termination is in the *deepest* part of the cord, where the central cineritious matter is situated. It appears, therefore, that the part of the medulla appropriated for sensation must be in the internal, well-protected recesses of the organ; where it is less likely to be reached by disease invading the exterior, than the column of motion, situated more superficially.

It will depend on the height in the spine at which the cord is diseased as to the extent of the body that will be paralyzed. If the disease be in the lower lumbar vertebræ, that is, below the termination of the cord, there may be an absence of paralysis: unless, as occasionally happens, the products of inflammation have extended upward, to involve the medulla above. In not a few cases, one extremity is more completely deprived of motor power than the other. Comparing the paraplegia resulting from disease with that from injury, it is remarkable that the former is seldom accompanied with loss of command over the bladder or rectum; and that when these organs are affected, it is commonly in a slight degree. Retaining sensation, the patient may have an urgent desire to pass water, but he will be unable to do so, and will require the assistance of the catheter. Again, the stools may pass at one time involuntarily, at others consciously. In general, the torpidity of the bowels renders it necessary to give aperients frequently.

The cases are comparatively rare in

which the loss of power in the limbs leads to the formation of bed-sores. If the patient be an adult, who suffers much pain at the seat of disease, making it difficult to shift his position, there will be danger of such sores; but not so great as in cases of paraplegia from fracture of the spine, when the feces and urine pass involuntarily, and the hips are constantly sodden in the filthy moisture. In a young person, on the other hand, whose body is light, in whom sensation has not been lost, and who can feel the irksomeness of lying for a long time in the same posture, we do not look for sores; he can turn himself by the use of his arms, change the position of his hips, and thus avoid the bad effects of pressure.

Spasmodic actions of the paralyzed limbs.—When the lower extremities are entirely bereft of voluntary power, they are subject, nevertheless, to convulsive actions; through some obscure morbid influence acting on the distal portion of the spinal cord cut off from connection with the brain. The spasms are the same that are witnessed when the cord has been destroyed by violence, or by the encroachment of tumors, ramollissement, etc. A frequent form of the attack consists in a sudden jactitation of one or both legs. While the patient is lying quiet, the limbs will suddenly be drawn up; they will be bent both at the knees and hips—so that the heels will come in contact with the back of the thighs, and the knees with the abdomen: the flexor muscles will then relax, and the limbs will fall straight, as before. In such cases the spasms are of short duration; but they may be repeated with great frequency, so as to cause much distress. A different form consists in the legs being drawn up, and then remaining bent. In these cases, the limbs and body will be so rigidly fixed, that the patient may be moved about in bed, in one mass, like a log of wood. Cases will be met with in which both the above forms are presented, at different times, in the same patient. The spasmodic actions, whether clonic or tonic, are apt to be excited by certain irritants; thus tickling the soles of the feet, pinching or pricking the skin, the act of moving, will bring on the sudden startings, or will aggravate the contractions of the rigidly bent limbs. Micturition and defecation sometimes, but rarely, excite attacks. Yet they frequently come on without any perceptible cause of irritation. When the patient is drowsy and about to drop asleep, he is peculiarly subject to be awakened by the limbs jumping.[1]

The pain occasioned by the spasmodic affections is sometimes excessive. In certain cases it equals, if it does not surpass, the agony of tetanus in its worst form: happily, in the majority the suffering is moderate and endurable. Sometimes, when the convulsions are strong, they shake the whole body, and communicate a painful jar to the diseased vertebræ. Again, if the patient have bed-sores, the concussion produces friction of the hips against the bedding, and that aggravates the ulceration or sloughing. When it is attempted to subdue the spasms by applying splints to the limbs, or by bandaging the leg that is affected to the one that is quiet, and fastening them, when thus secured, by India-rubber tubing to the bedposts, the plan commonly fails; the skin is liable to be frayed, and the pain is not diminished. There is no particular medicine that can be relied on for overcoming the convulsions. Good effect sometimes follows injecting morphia under the skin.

Diagnosis.—As intimated before, paraplegia consequent on caries of the vertebræ does not differ materially from that which may be caused by morbid affections of the cord, of various distinct kinds. The principal diagnostic symptom in spinal disease is, doubtlessly, the angular deformity. Observation shows that paraplegia of this kind does not occur till late in the disease, after the bodies have been partially destroyed. Consequently, if there be no distinct projection of the spinous processes, or rigidity of the vertebræ, to indicate excavation of the column, it is probable that the paraplegia depends on some other morbid affection. Again, palsy arising from caries is commonly distinguished by motor power being abolished while sensation is unimpaired. If the reverse be found, namely, loss of sensation with retention of motor power, it may be inferred that the cord is encroached upon by some morbid growth advancing from behind forward.

Prognosis in paraplegia.—Experience proves that, in paraplegia from spinal disease, restoration of the lost powers of the limbs is not uncommon. The mode in which recovery takes place appears connected with the bending of the spine at the seat of the caries. It has been previously stated that, in the majority of cases, the paralysis consists in the loss of function by the anterior column alone, motor power being the only property destroyed: whence it was inferred that but a comparatively small part of the cord was disorganized. It may, therefore, be conceived that, in proportion as the spine sinks under the pressure of the superincumbent weight, and the angle at the seat of disease becomes more acute, the sound portions of the cord above and below the morbidly affected part of the anterior column, will approach more closely to one another: and that, in certain cases, their respective surfaces may coalesce and unite. In that manner the continuity of the column will be re-established, and its function restored. If this view be correct, it will follow that, should ankylosis of the vertebræ have taken place before the diseased surfaces of the bodies have come in contact, and when a permanent gap has been formed between them, there will be little chance of recovery. The prognosis is more favorable in children than in adults; which may be ascribed in considerable degree, at least, to the coalescence of the sound portions of the cord adverted to being more readily affected in the former than in the latter, owing to the greater flexibility of the spine in early life. The writer had lately under his care a boy, six years old, with angular deformity in the dorsal region. Within a period of two years, his lower limbs were twice completely paralyzed: the first time, for six months; the second, after an interval of eight months, for four. He recovered from the paraplegia, but afterwards died from the effects of extensive abscesses.

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[1] "Contributions to the Pathology of the Spinal Cord," by William Budd, M.D. Med.-Chir. Trans., vol. xxii., p. 153.

The restoration of the power of the limbs, in some cases, is only partial. Certain groups of muscles continue paralyzed. This inequality in the condition of the muscles leads to particular forms of contractions and deformities, chiefly in the ankles and toes.

[The subject of the treatment of caries of the spine has awakened general interest within the last few years, and renewed attempts have been made to avoid the tedious treatment of absolute recumbency for a long period hitherto in vogue. For this latter to be effective it must be absolute, requiring not merely recumbency but the interdiction of all motion. The patient must be fixed either in a gouttière de Bonnet or bed-frame, so that the change of position necessary in nursing may be attended to without twisting the spine.

As a substitute for this, the method of treatment by fixation with plaster of Paris or other bandages or apparatus has deservedly attracted much attention.

No one who has watched a number of cases treated in this way can fail to acknowledge the great relief which is often afforded by a well-applied plaster-of-Paris jacket in suitable cases, but it is also true that they are not so universally beneficial as has been claimed.

It is also very doubtful whether suspension (as has been stated) pulls apart the diseased vertebræ on the principle of extension, or that this separation can be maintained by an appliance bearing down upon the pelvis for a base and pushing up upon the thorax as a surface for resistance. It has been demonstrated that in an advanced case of caries of the spine the bodies affected were not pulled apart by suspension,[1] and in early cases it is probable that the main effect of suspension is upon the physiological curves of the spine and not upon the pathological.

It is very exceptional for cases of caries of the spine to present themselves for treatment at a stage before the projection of a spinous process is evident. Such a projection results from extensive destruction of the anterior portion of the spinal column, a change which rarely takes place without such adhesions between the adjacent affected vertebræ as to limit motion.

It is however wrong to assume that the benefit derived from the plaster-of-Paris jacket is due entirely to its efficiency as a mode of fixation.

The more the spinal column is bent upon itself (with the concavity forward), as is the tendency in caries of the spine, the greater the pressure upon the diseased bodies from the superincumbent weight of the trunk and head. When the column is straight the pressure is diminished. If the column can be bent with the convexity forward there will be no pressure at the diseased point. The effect of suspension is of course to make a straight line of the curve; when the curve is pathological and not flexible this curve is not affected, but the normal part of the spine is brought to the vertical line, and on the application of a plaster-of-Paris jacket, prevented from bending forward.

A plaster-of-Paris jacket then, when properly applied, is a means of fixation in an improved position.

The flexible curves of the spine can be also corrected by placing the patient in a recumbent position. If the height of a person be measured when standing and also when lying flat upon a hard surface, it will be seen that the spinal column is apparently lengthened by this position. Plaster jackets can therefore be applied in this way, as has been recommended by Mr. Walker. (See also MINOR SURGERY.)

Before the application of the plaster bandages, the patient should be dressed in a close-fitting undershirt, and any bony projection should be protected from pressure by placing upon each side a thick pad; a folded towel should be placed on the abdomen, to be removed after the bandage has hardened, and thus allow space for enlargement of the abdomen from tympanites. This is not, however, always necessary.

[[1] Owen, Brit. Med. Journ., Feb. 28, 1880; see also Boston Med. and Surg. Journ., May 13, 1880.]

The bandages can be prepared by dusting plaster of Paris which has been but little exposed to the air upon any cloth with loose meshes. When the patient is placed in an apparatus for suspension the bandages are dipped in warm water (to which a little salt is added to quicken the "setting" of the plaster) and allowed to remain until the bubbles of air have ceased to rise. The bandages should be wound evenly about the trunk, and dry plaster from time to time be dusted on and rubbed in. If the bandages be made of the proper material, and enough plaster be rolled in the cloth, they will become hard very quickly, and the thin strips of steel sometimes incorporated in the jacket are not needed to give the bandage strength.

The amount of extension needed when suspension is employed varies according to the size of the patient and the seat and extent of the disease. The patient may be suspended either simply from the head by the use of a head sling, or with the addition of loops to pass under the axilla.

As soon as the jacket is sufficiently hard as to allow the patient to be lifted without bending or cracking, he should be placed flat upon a mattress until the appliance has become perfectly hard; the folded towel should be then removed and the bandage trimmed so as not to press on the axilla or thighs.

When instead of suspension, the recumbent position is used to straighten the spine, it is desirable that the plaster should not harden quickly, in order that sufficient time be given for the proper adjustment of the bandages; for this reason mucilage of acacia should be dissolved in the water to which the plaster of Paris is added, and strips of bandage passed through the plaster-of-Paris paste,[1] and laid one by one upon the bed, each bandage lapping the other. Three layers should be prepared in this way and the patient then placed upon it, and the strips of bandages placed around the trunk one after another. They should have been cut of sufficient length to encircle the trunk and allow a portion to lap. An efficient bandage can be applied in this way, but more care is required in preparation of the materials than when suspension is employed. Extension can be used while the patient is in a recumbent position, by the addition of a head sling and means of traction upon the lower limbs.[2]

The chief objection to the plaster jacket in treating a disease with as prolonged a course as caries of the spine, is that it is a fixed appliance and consequently unclean, and also that it is liable to cause chafing. To remedy these difficulties, as a substitute for plaster-of-Paris jackets, corsets of felt, leather, paper, and glue, have been used, moulded either to the figure of the patient or to a cast made from a plaster jacket, applied in the ordinary way.

These appliances can be readily removed, but they do not afford as thorough fixation as is given by a plaster jacket well applied.[1]

The object of treatment by means of steel apparatus is fixation. All apparatus designed to extend the spine by pressing upwards upon the axillæ and taking the base of support by a band encircling the pelvis are mechanically defective. The spinal column moves chiefly by bending forward, and to secure fixation this motion should be prevented. The simplest way to effect this is to straighten the spine by placing the patient in a recumbent position, and placing on the back an appliance consisting of two parallel strips of steel (without spring) bent to conform to the shape of the back, and being on each side of the spinous processes fastened at the bottom to a cross-piece which partly encircles the pelvis. An apron (with straps) placed upon the patient's abdomen and padded straps around the shoulders are buckled to the splint, and the spine is thus fixed.

To secure this fixation, however, great care must be exercised in the adjustment of straps, and fixing pads upon the steel uprights, in such a way that when the patient is standing the spinal column may not bend backward at that point, and thus increase the pressure on the diseased bodies. Such an appliance, if properly made and accurately adjusted, is readily worn by the patient, is easily removed, and is of great benefit, as has been abundantly proved by clinical experience. It however demands great care on the part of an attendant, and the constant supervision in the surgeon.

The object of this mode of treatment,

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[1] For another means of suspension, see New York Med. Journ., July, 1878, p. 37.]

[2] Walker, Lancet, Dec. 28, 1878, p. 915; Owens, Lancet, Nov. 28, 1878, p. 734; Brit. Med. Journ., Aug. 24, 1878, p. 281; Miller, Brit. Med. Journ., Nov. 8, 1879, p. 728; "A Modification of the Plaster-of-Paris Jacket," Wyeth, Richmond and Louisville Med. and Surg. Journ., 1879, xxv., 312; Hosp. Gaz., New York, 1879, v., 81; Lee, "Horizontal Extension," Trans. Med. Soc. of Pennsylvania; Davy, "Hammock Suspension," Brit. Med. Journ., 1880, p. 959.]

[1] Cocking, Brit. Med. Journ., 1878, vol. ii., p. 283; Med. Press and Circ., 1879, n. s., xxviii., 386; Med. and Surg. Reporter, March, 1878, p. 281; Lee, Proc. Phila. Co. Med. Soc., 1879, 48; New York Med. Record, 1879, ii., 571; Vance, New York Med. Journal, 1879, xxx., 160; Hunter, Boston Med. and Surg. Journ., 1880, p. 582.]

as originally proposed, was to transfer the superincumbent weight of the body from the bodies of the vertebræ to the transverse processes. That it would be mechanically possible to do this is probable, provided the affected vertebræ were not so far involved as to have become united by inflammatory changes. When, however, this has occurred, the effect of a brace is to fix in an improved position.

It is manifest that the mechanical problem required in fixation varies in different parts of the spinal column, and for this reason it is convenient to divide it into two parts, upper and lower. In the first it is necessary to provide some means for support or fixation of the head. In the second this is not necessary. The exact limit above which a head-support is needed is not exactly determined. According to some surgeons this is necessary in disease above the seventh dorsal; according to others the fourth dorsal.

The head-supports in use are: 1st. A bent rod fixed below in the appliance which encircles the trunk, and above bearing a sling which passes under the chin and occiput. 2d. A steel collar passing under the chin around the neck, and fastened behind to the apparatus fitted to the back. If this is properly adjusted, the weight of the head is partly supported by the rest under the chin, and all bowing forward is prevented.[1]

It may also be stated that the natural course of the disease varies according to its location. Paralysis is more common in disease of the upper portion. Treatment by surgical appliances is more effectual in the lower dorsal and upper lumbar region. Deformity is with more difficulty checked in the upper dorsal region.

It cannot be said that the methods of fixation have entirely done away with the necessity of recumbency in the treatment of caries of the spine. In some cases during certain stages it is best that the patient be kept absolutely upon the back. But it has been clearly shown that by means of surgical appliances recumbency need not be maintained (when it is required) during the whole course of treatment of the disease, and that the deformity resulting from the disease may be prevented from increasing or limited in its increase. Other cases progress to complete recovery under fixation by mechanical treatment, without any confinement or enforced recumbency.[2]]

Treatment of Spinal Disease.

The general treatment in spinal disease is founded on the same principles that guide us in hip-disease, scrofulous synovitis of the knee-joint, disease of the ankle, etc. The remedies are directed principally to sustain and strengthen a constitution originally weak and liable to be further debilitated by the effects of the disease. Hence, although it may be occasionally necessary to employ depleting measures for subduing temporary accessions of fever, or quelling short attacks of inflammation, they are adopted with reluctance, and the tonic system is otherwise pursued uninterruptedly.

Of local remedies, "rest" is deservedly placed at the head of the list. The object sought to be gained is twofold. First, by fixing the diseased vertebræ, we endeavor to prevent jarring and attrition between the rugged opposing surfaces of the carious bodies, and, by removing that source of irritation, to encourage the morbid action to cease. Secondly, by keeping the bones at perfect rest, we afford the parts the most favorable opportunity for becoming consolidated by ossific union.

The most effectual method of arresting motion between the diseased vertebræ, in aid of nature's efforts, is to place the patient in the recumbent position on his back; and to give him the greatest advantages whilst confined, it is desirable that he should be furnished with an invalid-bed, provided with conveniences for enabling him to lie upon it, day and night, without rising. If an ordinary couch be used, the patient will lie with greater security and comfort if the frame for the horsehair mattress, instead of being horizontal, be gently inclined downward from the top to where the hips come, and then be elevated (but to a slighter degree), with a double incline, for the knees to be bent over the angle. A hollow or socket for the reception of

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[[1] Chrystie, N. Y. Med. Record, Sept. 15, 1873; Blanchard, Chicago Med. Journ. and Examiner, April, 1878, p. 376; Putnam, The Doctor, Feb. 1, 1878, p. 46; Jourdan, Lancet, June 12, 1880.]

[[2] Consult, also, Trans. N. Y. State Med. Soc., 1863; Taylor, "Mechanical Treatment of Pott's Disease," Boston Med. and Surg. Journ., 1880; Sayre, "Spinal Disease," Trans. Am. Med. Assoc., vol. xxx., 1879; Lee, "Angular Curvature of Spine;" Shaffer, Pott's Disease; Saint Germain, Gaz. des Hôp., Dec. 9, 1877, p. 1134; Scriba, Berl. Klin. Woch., July 15, 1878; Fisher, London Med. Record, Oct. 15, 1879, p. 141; Madelung, Berl. Klin. Woch., Feb. 10, 1879, p. 78; New York Med. Record, Oct. 4, 1879, p. 327; 1878, p. 177; May, 1879, p. 450; Bird, Brit. Med. Journal, Oct. 11, 1879, p. 571; Willett, St. Barth. Hosp. Reports, 1878, xiv., 323–33; St. Germain, Union Méd., 1879, 3d s., xxxiii., 369–75; Roth, Brit. Med. Journal, London, 1879, ii., p. 891; Wood, "Double Extension," in Brit. Med. Journ., 1879, ii., 1023.]

the angular projection of the spine ought to be made in the mattress. Or a substitute may be contrived by filling an India-rubber pillow with sand, or suitable grain or seeds, and placing it under the patient's back, protected with blanket and sheet. In young persons, further security will be required, by enclosing the body in a stiff corset; and, perhaps, by strapping them down to the couch. It will add to the convenience if the bed-frame be portable, and capable of being easily transferred to the body of an invalid-carriage, or to a bench in the garden, with a view to the patient's getting fresh air.

It is an important duty of the surgeon to be peremptory in enforcing strict confinement in the recumbent position. He will find this task, of course, more difficult in children than in adults; and the principal cause is the freedom of the patient, in the majority of cases, from pain. Nevertheless, however moderate the symptoms with which the disease is ushered in may be at first, the incipient stage is a period during which a rigid observance of perfect rest ought to be insisted upon. And the time over which that care should extend ought not, even in the most favorable cases, including children, to be less than six or ten months. In patients approaching adolescence, the confinement must be longer.

If the case should proceed favorably, without pain in the back or abscesses coming forward, for the number of months specified above, the next practical question will be, concerning the propriety of liberating the patient from his long durance. That is equivalent to asking, how it may be ascertained that ankylosis has taken place; for it cannot be considered safe to allow the patient to get into the upright position till the bones have become strongly knit. Accordingly, in examining the angular projection, what has chiefly to be made out is, whether there be any motion between the affected bones; for if the part be perfectly stiff, it may be presumed that they are united. Atrophy of the muscles may assist in confirming the point. But it will not be prudent to rely on the solidity of the ankylosis altogether. The patient ought to be supplied with artificial supports. Space does not allow of a detailed description of the best kind of these instruments to be used in different cases; for, of course, they must vary, not only according to the situation of the disease, but the age of the patient. One general remark may be made, that the corsets are to be constructed much in the fashion of women's stays, so as to embrace the body above and below equally and generally; they ought also to be strengthened as much in front as practicable, to counteract the tendency to stoop forward. For giving them the proper stiffness, steel ribs are preferable to whalebone. In young, feeble children, whose bodies are extremely flexible, while their hips are too narrow for being used as a base of support, it may be found best to encase them in separate pieces of prepared leather, moulded to the body, and afterwards inserted in corsets; the lateral pieces or splints may be prolonged downward, to rest on the seat of the chair, and brought high enough to reach the armpits, so as to act as crutches while sitting.

Prone-couch.—A mode of reclining in the prone position, instead of on the back, has been much recommended. The method consists in making the patient lie upon his chest and abdomen, on an elevated frame, not unlike a desk, with an inclined board upon which his legs may hang: he is prevented from sliding by pegs at the top received into the arm-pits. The object of the position is, by fixing the upper part of the trunk, and allowing the hips and legs to glide down the incline, to keep the spine on the stretch, and so diminish the acuteness of the angle at the seat of disease. But such a design is opposed to the principles advocated above (see p. 308). It is evident that if the angular projection be diminished, the surfaces of the diseased bodies of the vertebræ, which ought to meet, will be kept apart, and ankylosis will be prevented. Moreover, as the patient cannot sleep, and cannot empty the bladder and rectum while confined on the apparatus, it will be necessary to move him frequently, to the great injury of the back. But it will, perhaps, be said, that although the employment of the prone-couch be not adapted to caries in its active stage, it may be advantageously used to improve the figure, when ankylosis has been effected. That desire on the part of patients, who have narrowly escaped death at the price of being deformed, to have their cure made absolutely perfect by getting rid of the hump on the back, may be natural; but it is scarcely necessary to say how utterly vain such hopes are.

Counter-irritants.—It is not long since, that in cases of angular deformity, issues were almost invariably ordered, on each side of the protuberant vertebræ, whether the patients were young and weak, or the disease acute or chronic, or there were abscesses or paraplegia. They had a debilitating effect, and were attended with much constitutional irritation. According to the practice of the present day, issues are reserved for subduing casual accessions of the morbid action, when the pain is great, or when there is a threatening of paraplegia. They effect all their good in a short time, so that it is not necessary to keep them open. Blisters give rise to so much general inconvenience that they are seldom had recourse to. Compound tincture of iodine, as a local application, has supplied us with an efficient substitute for these coarser remedies.

Disease of Atlas and Axis.

Disease affecting the two highest vertebræ of the spine has certain peculiarities which entitle it to separate consideration. The same cause which makes accidents to those bones more dangerous than elsewhere,[1] renders morbid action more perilous. The portion of spinal cord contained within the ring of the atlas is the most vital in the nervous system. Hence, whatever tends to weaken the joints in that part, exposes the patient to the hazard of sudden death, or of paraplegia including the whole body below the head.

Both atlas and axis, especially the former, differ from the other vertebræ in their anatomical structure. The atlas is deficient in the part that corresponds to a body; and there is no fibro-cartilage either between the axis, or the occipital bone and it: hence, as these structures are the proper seat of caries, it may be expected that the morbid process which attacks the two bones will differ from the ordinary disease of the spine.

The joints particularly subject to be affected are those between the atlas and axis. And a reason may be assigned for their being peculiarly prone to disease. The term "axis" implies that the vertebra so called is the centre of the rotatory movements of the head; and as the spokes in a carriage-wheel inserted into the axle act upon that central point with great lever power, so that when a break-down occurs it is the axle that gives way, a corresponding impulse is directed upon the pivot of the axis, by sudden violent rollings or twistings of the head. These shocks and sprains, often repeated, predispose the articulations, in a delicate patient, to disease.

The morbid action thus set up in the atlo-axial joints is similar in pathological character to what commonly occurs in the wrist, elbow, knee, etc. Proceeding generally in a chronic form, it gives rise to a gradual softening and spongy thickening of the synovial and fibrous tissues that connect the vertebræ; and subsequently to ulceration of the cartilages, and superficial corrosion of the bony structures. The disorganization will go on in most cases to an extreme degree without signs of abscess.

That which contributes principally, as intimated before, to the importance of disease in this locality, is the danger threatened to the spinal cord at its most vital part. Owing to the head being sustained on the atlas, and the ligaments which bind the latter and the axis ceasing to be able to retain them in position, the weight of the head causes the atlas to glide forward and downward upon the axis. This movement implies that not only are the articular surfaces separated from each other, but that the odontoid process of the axis is detached in an equal degree from the surface of the atlas which rolls upon it. Now, it is from this last-mentioned change that the risk to the spinal cord chiefly arises. The anterior arch of the atlas cannot be separated from the odontoid process, except by the stretching and elongation of the transverse ligament which embraces the neck of the process, and of the accessory restraining ligaments. Accordingly, if the weight directed on the atlas should be suddenly increased while this extension is in progress, and the ligaments are correspondingly weakened, the danger is imminent of the latter being ruptured. And should that event occur, there would be nothing to prevent the atlas, with the head as its freight, from sliding abruptly forward on the surface of the axis to its utmost reach. The consequence would be, that the portion of spinal cord contained within the ring of the atlas would be compressed by the posterior arch of that bone against the odontoid process in front, and be thoroughly crushed, and the patient's death would be instantaneous.

Case.—The patient, a butler, past the middle age, and corpulent, had for some time stiffness in the neck, with pains in the head and arms, supposed to be rheumatic. When seen by the writer, a large swelling extended from the upper third of the neck behind, to the highest part of the occiput, concealing the forms of all the bones which it covered, except the spinous process of the axis, which appeared unduly prominent. He could perform the nodding, but not the rotating motion, of the neck. The vertical axis of the head was advanced perceptibly too far forward, in comparison with the vertical axis of the neck; the effect apparently of the head having been transported to the front slightly beyond its proper plane in relation to the spine. The disease was seen to be atlo-axial, and he was removed to the hospital. Progressive paraplegia soon commenced, and it proceeded downwards; first one arm became weak and then paralyzed; shortly afterwards the other also became weak and paralyzed;

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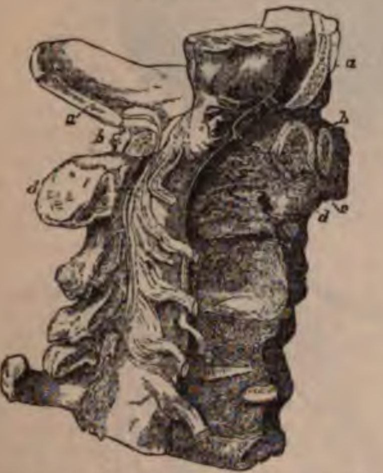
[1] See Injuries of the Back, Vol. I., p. 807.

and the lower extremities followed the same successive course. But before the legs were totally paralyzed he died, his death having been accelerated by a severe attack of bronchitis.

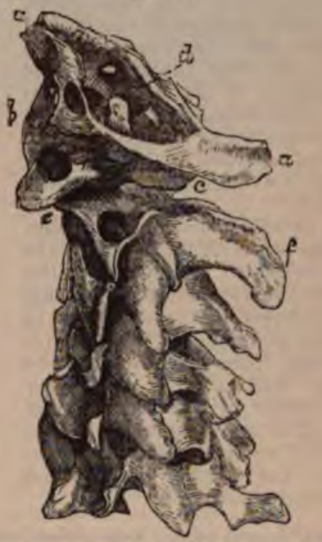
Fig. 686.



Atlo-axial disease. Figure from specimen in Middlesex Hospital Museum. *a, a.* Portion of occipital bone, in proper relations to atlas. *b, b.* Section of atlas. From destruction of the ligaments of the atlo-axial articulations, the atlas has slid forward, borne by the weight of the head, and has carried the odontoid process of the axis with it. *c.* Odontoid process of axis: loosened at its base by disease, it has been carried forward in connection with the atlas. *d, d.* Section of axis; its odontoid process detached: its articulations with the atlas, and with the body of third vertebra, and its body, all much diseased; the great projection backward of the spinous process in reference to the occiput and atlas, is a result of the gliding forward of the latter. Within its canal the spinal cord is seen bent at an obtuse angle; the consequence of the portion contained in the foramen magnum and atlas being carried forward, while that in the axis has been stationary.

But, happily, these cases are not always so formidable. In not a few, the transverse and restraining ligaments undergo extensive stretching of their fibres without being ruptured. They continue, therefore, to retain a hold of the atlas; and to keep a check upon it, as it glides forward upon the axis. Besides, the connecting structures in general surrounding the diseased vertebræ are agglutinated by deposition and induration of coagulable lymph, and the shifting movement proceeds slowly. Thus displacement may take place to an extraordinary degree. In many cases the atlas will be transported to the front to such a distance, that less than one-half will remain resting on the axis, the anterior part protruding unsupported beyond its level. The posterior arch of the atlas will then cease to be in relation or coaptation to that of the axis; it may be transported so far forward, that it will even bisect the vertebral canal into equal parts. Hence about a moiety of the area of the canal appropriated for holding the spinal cord and its membranes may be absolutely cut off. It might have been conjectured that a loss of substance, and alteration of figure so great as this description implies, would have been altogether incompatible with the cord retaining its functions. But experience shows that if the morbid action be chronic, and the dislocation take place slowly and gradually, the disease may run its course without paraplegia ensuing, and the patient will recover with deformity of the neck alone. Again, it is found that in those formidable cases in which para-

Fig. 687.

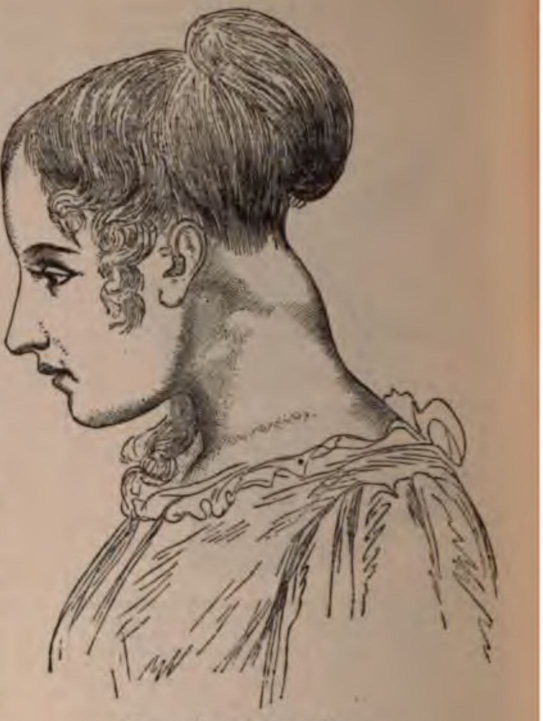


The specimen from which the figure was taken was removed from the body of a man found dead in the streets. There was fracture at the base of the skull, all round and at a short distance from the foramen magnum; the boundaries of the fracture being seen in the figure. *a, a.* Portion of occipital bone, insulated by the fracture. *b.* Anterior tubercle, on anterior arch of atlas. *c.* Posterior tubercle, on posterior arch of axis. *d.* Odontoid process of axis. Its situation corresponds nearly to the centre of the vertebral canal, at the level of the foramen magnum and atlas. *e.* Body of spinous process of axis. About three-fifths of the articulating surfaces of the atlas have been displaced forward on the corresponding surfaces of this bone, thereby accounting for the projection anteriorly of the front segment of the atlas. *f.* Spinous process of axis. The posterior segment of the ring of the atlas crosses the canal of the axis nearly in its middle. The distance between the posterior surface of the odontoid process, and anterior surface of the posterior arch of the atlas (the antero-posterior diameter of the vertebral canal), measures from a third to a quarter of an inch; that between the odontoid process and the anterior arch of the atlas, at the original sites of their articular facets, is five-eighths of an inch. The space between these points is traversed by an irregularly cylindrical beam of bone which unites the two surfaces: this new growth of bone is not visible in the drawing, but it had obviously been formed during the process of displacement of the atlas upon the axis, and attests the slow rate at which it had taken place. For a more detailed description of the specimen, accompanied with a drawing representing it in a different view, see Med.-Chir. Trans., vol. xxxi., p. 289.

plegia both of the upper and lower extremities has occurred, the patients may regain the power over their limbs, and be restored to perfect health; the spine, of course, remaining distorted. The phenomena are to be accounted for according to the pathological principle already adverted to (p. 317). The diminution in the substance and the disfigurement of the cord generally have been consequent on a slow process of interstitial change; and it has been seen that deviations from the normal size and shape, of the most surprisingly great kind, can be made in the spinal cord, as well as the brain, without sacrifice of their endowments, if wrought in that gradual manner.[1]

As in spinal disease generally, persons of scrofulous habit are more prone to be affected in the atlo-axial articulations. The last case observed by the writer was in a young woman, who, just after recovering from disease in these joints, had angular deformity from caries in the dorsal vertebræ. The most common age at which it commences is near puberty; but neither infants nor adults are exempt:

Fig. 688.



Disease of cervical vertebræ.

The girl, aged fifteen, from whom the drawing was taken (Fig. 688), had continued in her situation as a domestic servant, till three weeks before her admission into the hospital, at which time the neck was distorted as represented in the figure. The disease had apparently commenced four months previously, but it had caused so little pain or inconvenience that she had not been obliged to give up her work during its progress. She complained of pain darting from the swelling in the neck upward to the crown of the head, and downward over the shoulders, and along the arms. She had also slight incontinence of urine. The most prominent part of the swelling in the neck was formed by the spinous process of the axis; above which, and between it and the occiput, a distinct hollow could be felt. Chiefly by rest and counter-irritants she improved so much that in six weeks she was discharged. But three weeks afterwards she was readmitted on account of an aggravation of the former symptoms, and there being a weakness of the lower extremities, which caused them to sink under her when she attempted to walk. In a month she was sufficiently recovered to be sent to a convalescent hospital at the seaside. She subsequently called at various times at the hospital, to show that she had regained her strength completely. A cast from the neck is in the Museum of the Middlesex Hospital.

Symptoms.—A general swelling around the nape of the neck, attended with stiffness, and pain in motion, are the earliest indications of the disease. The patient will prefer the recumbent position to being erect; keeping his head sunk in a soft pillow. When upright he will steady his head by placing a hand on each side; and if asked to rotate it, he will stiffen his neck, and turn the whole body round. The nodding motions he will be able to perform. A sudden jolt, or a tap with the hand on the crown of the head, will give pain. As the swelling of the upper part of the neck may probably be mistaken at first for enlargement of the lymphatic glands, or for deeply-seated abscess arising from some other cause, the most certain mode of deciding the question as to the real nature of the disease, is to observe accurately the relative position of the spinous process of the axis to the occiput. Notwithstanding its large size, that process is not readily felt in the normal condition; it lies sunk in a hollow, arched over by the ligamentum nuchæ. But in atlo-axial disease the spinous process becomes distinct, not only to the touch, but to the eye. That change, however, is not consequent on the axis itself protruding; for this bone is stationary; the spinous process appears to project merely because the atlas, carrying the skull upon it, glides away to the front, thereby leaving it more exposed and defined. In conformity with this explanation, it will be perceived that the head droops, as it were, upon the neck; that the chin and face generally are advanced preternaturally forward in comparison with the throat, while the back of the head is deficient in rotundity and fulness in reference to the line of the spine. It may happen that one side of the atlas will move forward more than the other, when there will be added a little obliquity to the position of the head.

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[1] In a specimen of consecutive dislocation of the atlas upon the axis described by Mr. Paget, the displacement exceeded what has been stated in the text. Fully two-thirds of the atlas must have been entirely thrown off the upper articulating surface of the axis. On measuring the part of the vertebral canal available for holding the spinal cord, it was found that the distance was only two lines from the odontoid process, and three lines, at the most, from the body of the axis to the posterior arch of the atlas (the normal measurements being from nine to eleven lines). In the neck of the odontoid process there was a deep indentation; which proved that the transverse ligament had retained its hold of the atlas to the last without being ruptured; and that the displacement had taken place slowly.—Med.-Chir. Trans., vol. xxxi., p. 285.

Prognosis.—Patients may pass through all stages of this complaint, till it ends in deformity and ankylosis, without any positive indication of the spinal cord having been affected. Yet the surgeon cannot fail to be in constant apprehension, and to watch every symptom narrowly. Pains darting upward to the back of the head, and simultaneously downward over the shoulders and clavicles, perhaps give the first alarm. The latter sensations are sometimes prolonged to the finger-ends, accompanied with slight muscular weakness. Such symptoms alone might be explained by supposing that the roots and trunks of the nerves given off from the cord in the neighborhood of the disease, had become affected by the process of displacement and morbid action external to the spine, without the medulla itself being involved. But prudence will not allow that view to be too much relied upon. Should there be added any symptom of the lower extremities becoming paralyzed —as a tendency to trip in walking, or a sense of pricking or of numbness in the feet—the conclusion will at once be drawn that the morbid action has penetrated to the medulla. In certain cases the paralysis of the upper and lower extremities will be but imperfectly pronounced; and it will pass off. In a single case seen by the writer, the muscles became affected with tonic spasm; the whole body was so rigid that on turning the patient in bed she rolled with the stiffness of a corpse having rigor mortis; that condition lasted for a month; it gave place gradually to ordinary paralysis, from which she eventually recovered. When the paraplegia is complete, the patient is in a singularly helpless state, being deprived of voluntary power and sensation both in the upper and lower extremities at once. Yet, notwithstanding the apparently hopeless condition of patients in these cases, experience proves that they frequently recover. The prognosis will be, of course, more favorable in young persons than in those above the middle period of life. With his colleague Dr. M. Crawford, the writer attended a man, whose age was forty-eight, for disease in the atlo-axial articulations; during six months his whole body, from the head to the toes, was paralyzed; yet he eventually recovered, with his neck merely stiff and distorted.[1]

Treatment.—In disease of the atlo-axial articulations, the utmost danger would be incurred if the patient fell forward on his head; in its stretched and attenuated condition the transverse ligament would readily give way, and the atlas would thus be free to slide forward and compress the spinal cord by its posterior arch. Special care is, therefore, required to preserve the head and neck of the patient in a state of perfect rest. Accordingly, constant uninterrupted confinement in the recumbent position is necessary. And the patient's head ought to be laid on cushions, which will prop it equally on every side. For that object, the India-rubber pillow, stuffed to a proper degree of firmness with grain, so that it may easily be pressed into a hollow which shall fit the back of the head and nape of the neck, is to be used. Or the sand-bags recommended by Mr. Hilton will be more easily procured. A band ought also to be passed over the forehead, from the sides of the pillow, to restrain motion. In the event of the patient being restless and liable to lift the head inadvertently, as during meals or sleep, it is a useful precaution to have a shield moulded, either in gutta-percha, or prepared leather, to the back of the neck; this ought to take in the shoulders below, and reach to the vertex above, so that it may be secured by bands both to the shoulders and head, to arrest movement.

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[1] See a paper by Sir William Lawrence, "On Dislocations of the Uppermost Vertebræ of the Neck," in Med.-Chir. Trans., vol. viii. Also "Lectures on Pain and the Therapeutic Influence of Rest," by Mr. Hilton; Lecture V. A very remarkable case of disease of the superior cervical vertebræ, with intrusion of the atlas and axis, through the occipital bone, into the cranium, has been communicated by Dr. Lochee and Mr. C. H. Moore to the Lancet. See number for November 23, 1867. The preparation is in the Museum of the Middlesex Hospital.

Necrosis of atlas.—Before quitting the subject of diseases of the upper vertebræ, a rare affection of the atlas may be briefly noticed. This consists in necrosis and exfoliation of that part of the anterior arch of the bone which corresponds, in other vertebræ, to the body. The disease is connected with ulceration of the back of the pharynx; and it has been commonly observed in syphilitic patients. In some recorded cases, the whole thickness of the bone has come away, as shown by the articular surface of the odontoid process of the axis being visible. From the patient's surviving, it cannot be doubted that the insertions of the transverse ligament had been preserved entire; and that it had retained its hold of the process. A sloughing ulcer in the posterior fauces, with occasional attacks of difficult deglutition and breathing, have been the most prominent symptoms. When the fragment has been picked away, the sore has healed, and the patient recovered. It need scarcely be said, that a patient who has such a threatening disease, in a situation of so much danger to life, is in a critical condition while the dead portion of bone remains as a source of irritation, and that the greatest caution is demanded to protect him from sudden bending forward of the head.[1]

ORTHOPÆDIC SURGERY.

BY W. J. LITTLE, M.D.

Revised by E. H. BRADFORD, M.D.

[IT seems desirable that the word "orthopædic" should be spelt "orthopedic." Both ways are sanctioned by usage, as is also the practice of substituting e, as well as the diphthong æ, for the Greek αι. The term "orthopedic" is borrowed from the French, who coined the expression, spelling it without the diphthong, and there seems to be no good reason for disregarding the simpler way of writing the word.

Webbed Fingers.

All the fingers may be involved in this deformity, but usually only two fingers are joined.

In dividing the web, it is best to make an opening at the proximal end of the web, and allow it to heal before dividing the whole. This can be done by a galvano-cautery and the introduction of a foreign substance, such as a piece of silver wire or a piece of wood, until cicatrization has taken place, when the remaining portion can be divided. Sometimes it is feasible to perform a plastic operation, dissecting up the skin on the dorsal and palmar surface, dividing the web, and wrapping the flaps around each finger. This method, however, is not always successful.[2]

The other malformations of the fingers and toes may be classed as those caused by the presence of supernumerary digits; those with unnatural union of parts; those with a deficiency. These deformities are sometimes hereditary.]

Since the labors of Stromeyer, published in 1831, an important class of affections, denominated contractures and deformities, has deservedly much engaged the attention of the surgeon. Scarpa in 1803, Jörg, 1806, Rudolphi, 1823, Delpech, 1825, Dupuytren, and others, had, without much immediate fruit, endeavored to remove the obscurity in which this class of affections was involved. Their inquiries happily served to direct the researches of Stromeyer into a proper direction. The

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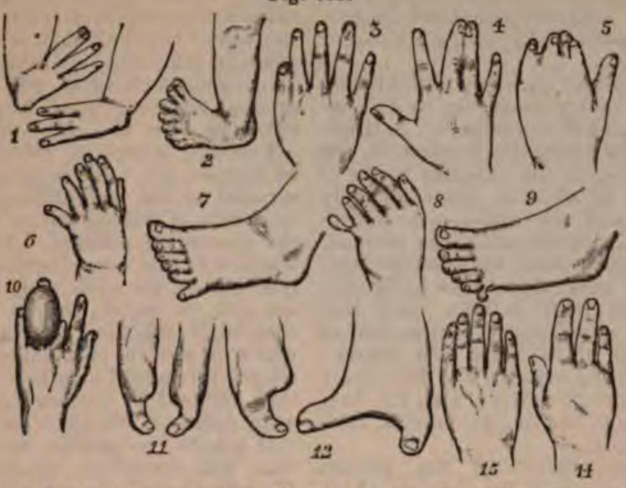
[1] See case narrated by Mr. Keate in Medical Gazette, vol. xvi., 1835. "A Case of Exfoliation of the Anterior Arch of the Atlas," by Mr. R. Wade, Med.-Chir. Trans., vol. xxxii., p. 65. Lectures by Mr. Hilton, op. cit., p. 99.

[[2] New York Medical Journal, Sept., 1878, p. 298; consult also Brodhurst on Deformities, and Annandale, Malformations of Fingers and Toes.]

Fig. 689.



Types of the different kinds of deformities of the hands and feet. (Bryant.)

term orthopædy has become generally used to signify the treatment of this class of affections.

The pathological nature of the affections relievable by surgical orthopædic treatment, often by division of tendons (tenotomy), is various. They consist mainly of alterations, in form and movement, of the articulations, especially of those belonging to the lower and upper extremities. These spring—

1. From accidental injuries of articulations; undue pressure and strain; inflammation of joints or contiguous parts, particularly those succeeded by suppuration and its consequences.
2. From derangement of the cerebro-spinal system, leading to paralysis or spasm and contraction.
3. From congenital influences, the varieties of club-foot, for example; malformations.

Orthopædic surgery comprehends, therefore, a multitude of abnormal forms of the muscular, ligamentous, and osseous systems, of which some are treated elsewhere in this work. On the pathology of deformities arising from diseases of the joints, the reader is referred to the essay on those diseases. Rachitic deformities are treated of in the essay on the SURGERY OF CHILDHOOD; spinal curvatures, in that on DISEASES OF THE JOINTS; strabismus, with DISEASES OF THE EYE; malformations, with the SURGERY OF CHILDHOOD; burn-contractures, under PLASTIC SURGERY. The affections which we have here to consider are principally those which can be remedied by division of tendons, by mechanical extension, or by both of these means combined.

Before proceeding with the description of the individual contractures relievable by tenotomy, it will be well to consider the circumstances which give rise to contraction and deformity, and to inquire into the condition of the muscles and tendons which renders their division necessary. It is now a well understood law of pathology, that if any part of the body, into the composition of which the muscles enter, be maintained in a state of absolute repose, or be habitually kept in one position, so that the origins and insertions of particular muscles are constantly approximated, whilst the points of origin and insertion of other muscles are consequently proportionately separated, a shortened, contracted condition of the first set of muscles, and an elongated, weakened state of the second set of muscles, are produced. This is illustrated by what occurs during a simple fracture or other injury of an extremity. If the elbow for example, be for any reason retained for a few weeks in the bent position, the muscles on the flexed side of the member become stiff and contracted, and are only gradually restored to their natural mobility by active and passive exercises and use, whilst the stretched-out and weakened extensor muscles recover but slowly their full power of extending the implicated articulation. The state of things just described is aggravated when inflammation, exudation, suppuration, loss of cutaneous or more deeply-situated tissues, and consequent adhesions and cicatrices, interpose pain and physical obstruction to the restoration of complete mobility. The greater duration of the disorder increases the probability that persevering or active remedial means will be required to obviate the shortening of one set of structures and the elongation and weakening of the opposite set. This shortening and contraction occur more rapidly during the earlier years of life.

The influence of paralysis in producing contracture varies according to the nature and extent of the seizure. A single muscle, as the sterno-cleido-mastoid, the tibialis anticus, or the external rectus of the eye, may be more or less completely paralyzed; and the antagonist sterno-mastoid, the gastrocnemius, the peronei, or the adductor oculi, may become contracted. Or several muscles habitually associated in their actions may lose their power of voluntary contraction, as the extensors of the wrist and fingers; and the opposing muscles also habitually associated in their actions, viz., the flexors of the wrist and fingers, become relatively shortened.

The demonstration of the precise amount and nature of the changes which occur in the central and peripheral parts of the nervous system, as far as apparent cause and morbid anatomy can teach us, and the determination of what particular functions of the muscles are primarily disturbed, belong to the special pathology of the nervous system, which need not here be entered upon. Few paralyses occur without some degree of contraction ensuing as a consequence, either directly from the impairment of the balance of muscular activity, or from forced repose or maintenance of the part in a particular position.

The induction by abrupt spasm of a more or less rigid, more or less permanently contracted state of a part, is obvious and easily intelligible; but the spasm which produces many persistent deformities is not always of that active, prompt, or tonic kind which is illustrated by certain cases of non-congenital wry-neck and club-foot, but is usually more slow and progressive, as seen in many children's cases of foot-deformity. The contraction in congenital club-foot and in the majority of congenital distortions can, we believe, be assigned only to a preternaturally excitable or spasmodic condition of the muscular fibres of the shortened muscles. In many cases, even when the shortened muscle has been set free by tenotomy, the morbidly excitable retractile disposition of the muscle often shows itself again after reunion of the divided part, and the cessation of employment of the mechanical or other means by which the affected muscle had been kept in an elongated state.

This contraction of certain muscles in congenital club-foot, which, for want of any other appropriate term, is designated spasmodic, is therefore very different from the active powerful retraction which occurs in certain comparatively sudden non-congenital cases, and in which the will of the individual is powerless to effect an improved condition of the limb. In congenital club-foot, and in analogous gradual non-congenital talipes in which paralysis does not exist, if the child is old enough to exercise volition, the affected muscles are to a certain extent subservient to the will, although volition is incapable of willing entire relaxation of the contracted muscles. Thus the contraction in this non-congenital non-paralytic talipes, the early stage of which we are able to watch, throws light on the congenital affection, the early stage of which is hidden in the uterus. In non-congenital cases of months' or years' duration, induced by cerebro-spinal affection or by reflex (?) disorder, the vital abnormal spastic contraction co-exists after a time with secondary structural change. We sometimes, however, before structural change has taken place, have an opportunity of witnessing that, although the patient walks with the heel, for example, much elevated, yet when he is seated, even with the knee extended, he can voluntarily bend the ankle,—contact of the sole with the ground exciting abnormal contraction. Further light is thrown upon the nature of the contraction in congenital club-foot by the observation that, during sleep, even in very young infants, the affected foot can be more readily straightened; also that, like as in certain cases of adult hemiplegia, when the child yawns and stretches out the limbs, the inversion of the foot often disappears. This observation would show, that whilst in the ordinary state of the infant's nascent volition the adductor muscles (the tibiales) overpower the abductors (the peronei) and invert the member, the act of yawning, with its complicated reflex activity of inspiratory muscles, and of associated muscles in the extremities, neutralizes the peculiar disturbance of muscular activity on which talipes varus depends.

It seems as if in congenital club-foot and analogous distortions a stimulus or irritant were present in the medulla spinalis, acting upon certain ganglionic cells there, which keeps the affected muscle in a state of tonic contraction, yet not sufficient to neutralize the stimulus of the will within the limits of movement permitted by the structural shortening of the member. Many non-congenital spastic contractions appear allied to the condition which prevails in some states of chorea, in which, when the will would permit or cause contraction or relaxation of a particular muscle, an involuntary influence excites contraction, interferes with, and frustrates the voluntary effort. In more intense spasmodic contractions the will is entirely overpowered before structural shortening supervenes to effect the same end.

[A consideration of the nature of the paralytic deformities involves a study of the paralytic disorders of childhood; a subject which has attracted a good deal of attention in the last decade, and which belongs properly to the department of medicine. A large number of these deformities are the result of the so-called infantile paralysis, or, more properly, myelitis of the anterior horns. This affection is characterized by a sudden onset of paralysis, affecting one or more limbs, and followed by progressive improvement for a while; so that a limb totally paralyzed may, in the course of a few months, regain power either entirely, or with the exception of certain muscles. Those muscles or groups of muscles which remain paralyzed after the first year following the initial onset are to be regarded as permanently useless. (Charcot, Volkmann.) These groups are usually those on the anterior surface of the thigh and leg, or the parts which are kept on the stretch when the limb is flexed, a position usually assumed when the child is unable to stand or unwilling to be recumbent all the time. The muscles on the posterior surfaces are those more frequently spared or less injured. Hence the theory has been suggested that a cause of this permanent paralysis, or rather such of it as is not due to the central lesion of the cord, is the fact that the weakened muscles have been overstretched, while the others which regain power have been protected from strain and subsequent fatty or fibrous degeneration. The deformities are not, therefore, according to certain writers, due to a spasm of certain muscles, but to the position the limbs assumed; a position which becomes permanent as the protected muscles develop and the stretched muscles become enfeebled.[1]

Of the "spastic distortions," a certain number are those which are due to cerebral palsies, and some come properly under the head of Spastic Spinal Paralysis.[2] It is probably this class of affections which Mr. Adams mentions as deformities with rigid muscles, and which are interesting to the surgeon chiefly from the fact that they are not as a rule much benefited by treatment.

The surgical treatment of ordinary infantile paralysis and the resulting deformities must be regarded as unsatisfactory also, if it be expected that by surgical interference a cure can be effected; much benefit can, however, be afforded by correcting the deformities and by furnishing proper supports. The deformities can be corrected without the employment of tenotomy in a majority of cases; there seems, however, to be little disadvantage from its use. The supports required vary in each case, and much care is required in the proper selection of them. The object of apparatus after the deformity is corrected is to prevent the enfeebled limb from giving way when the weight of the body is thrown upon it. In paralyses of the muscles of the leg, the inclination of the foot is toward a position of varus or valgus, with or without the dropping of the forepart of the foot. This deformity is to be treated as those from ordinary congenital club-foot, except that support will be required after the foot has been brought into place. When the extensor muscles of the leg are affected, it is necessary to prevent the knee from falling forward, or the patient is unable to stand. This can be accomplished without difficulty by means of apparatus devised for the purpose, and locomotion becomes possible. In paralyses of the upper extremity little is to be gained by mechanical treatment.]

To resume, then: clinical observation of non-congenital deformities, springing from derangement of the nervous system, teaches that there are several modes in which they are produced. These modes are as follows:—

1. Paralytic distortions.
    - *a.* Certain muscles only being partially or wholly paralyzed, their antagonists slowly contract the dependent articulation.
    - *b.* The muscles of the part in general being partially or wholly paralyzed, the contractility of the greater mass, as of the flexors in the extremities, slowly contracts the dependent articulation.
2. Spastic distortions.
    - *a.* The contraction is severe and prompt, the will being quite overpowered or absent.
    - *b.* The contraction is gradual, as in the majority of (non-paralytic) cases of non-congenital talipes, the will not being wholly overcome (those reputed from teething, for example), but restricted by the morbid innervation, and in time by structural shortening.

[[1] Volkmann, Klinische Vorträge; Taylor, Infantile Paralysis; Wharton Sinkler, Am. Journal Med. Sci., April, 1875; Schultze, Virchow's Archiv, lxviii., pp. 120–128; also Schmidt's Jahrb., 1879, p. 135, Bd. 182, No. 5; W. Adams, Lancet, Nov. 24, 1877; Seeligmüller, Jahrbuch f. Kindesheilkunde, 1879, xiii., Bd. 4, p. 315; Althaus, Infantile Paralysis, London, 1878.]

[[2] Tabes Dorsalis Spasmodique, Charcot; described by Erb, Allg. Med. Central. Zeitung, Nov. 21, 1877, and others.]

c. The contraction is gradual but severe, as in the deformities which sometimes accompany imbecility in children. It is probable, in this form, that the contraction is intensified by the co-existence of an enfeebled condition of general volition, a general inertia favoring repose of members, and a greater amount of structural change.

Secondary changes.—From whichever of the above causes a constantly contracted state of an articulation or limb may have proceeded, the state of things consisting of the inability of the individual to put the part, by the action of the will, through all its proper movements is called a deformity. But if the patient by means of his own hands, or if the surgeon, can overcome the contraction, and put the affected part through its proper movements, no deformity is in reality seen to exist. Positive deformity may early exist, when original disease of the joint has, besides producing contraction, ended in more or less considerable alteration in form and structure of the articulation. But almost equally serious (secondary) deformity may ensue through the influence of the now ill-regulated muscles of the joint, especially when these act upon tissues impaired by disease—the production of sub-luxation for example. In the lower extremity, the effect of the weight of the body being borne upon the member in improper directions is a very important cause of secondary deformity, adding greatly to the obstacles to restoration. Thus a not severe case of congenital club-foot, remediable in point of form in a few weeks before walking has commenced, may subsequently require treatment of months or of years; or, from the deteriorating cause above mentioned, be rendered irremediable.

We may now pass to the consideration of the means employed in Orthopædic Surgery for the rectification of deformities. This department of practice avails itself of much that is common with general medicine and surgery.[1] Special orthopædic means are, the relieving of the shortened parts by the employment of mechanical instruments, or mechanical power exerted by the hands of the surgeon or assistants, sometimes with the aid of the benumbing influence of chloroform, and by division of one or more of the contracted muscles, tendons, and fasciæ.

Tenotomy, myotomy.—In this operation the necessary relaxation of muscular resistance and of accompanying structural shortening is effected by severing the muscle at its tendinous portion. The principles laid down by Delpech for the performance of this operation are followed in the present day. It is remarkable that Delpech never carried out his own principles.[1] The discovery and application of subcutaneous tenotomy belong to Stromeyer. Many alterations in the mode of applying these principles have been made since the original labors of Delpech and Stromeyer. Various knives for severing tendons (tenotomes), and a great variety of mechanical extension-apparatus, have been devised. In this place only the means in most general use in this country will be described.

In describing the several distortions in the treatment of which tenotomy and mechanical treatment may singly or conjointly be requisite, no nosological order will be adopted. We will commence with congenital club-foot (talipes varus congenitus), because it is one of the most common distortions which the surgeon has to treat, and because it has formed the basis of extensive pathological and therapeutical research. The consideration of the scientific treatment of club-foot will, therefore, best illustrate the principles upon which the management of all other distortions should be conducted.

No other deformity exhibits in a greater degree the incidents of orthopædic experience.

Congenital Club-foot (Talipes varus congenitus).

It is undesirable to attempt here even a sketch of the history of the acquaintance of our profession with club-foot. It will suffice to mention that the subject engaged the attention of Hippocrates amongst the ancients, and of Scarpa amongst the moderns. But it was not until the genius and energy of Stromeyer were combined with a sound acquaintance with the principles and practice of modern surgery, that the complete treatment of severe club-foot became possible.

Anatomy of club-foot.—Former opinions on the anatomy of club-foot may be advantageously passed over.[2] In 1837, and subsequently, the author laid down the essential characters of the anatomy of club-foot.[3] The subject has since been carefully and successfully studied by Mr. William Adams.[1] The general result of observations of this matter is the confirmation of the opinions emitted by the author in 1837 and 1839,[2] that club-foot consists of a threefold alteration of the form and position of the foot, the heel being elevated, the toes turned in, and the internal margin of the foot raised from the ground, owing to abnormal action and shortening of the principal, if not of all the muscles of the inner and back part of the leg. Perhaps, also, at least in the severer forms, those in which the sole is much contracted, the plantar muscles participate in the primary affection. The ligaments, fasciæ, and integuments on the contracted side of the member are also shortened, whilst the similar tissues on the opposite side are elongated and weakened. These passive tissues follow the fortunes of the active organs—the muscles, on which they are in the main dependent, and become thus secondarily affected. The bones, before and after ossification, suffer in proportion to the intensity of the muscular contraction, and probably in proportion to the earliness of the period of uterine existence at which the distortion commenced; and especially in proportion to the period that elapses after birth, during which the passive osseous structures remain at the mercy of the active muscular agents. The bones further suffer as age advances, by bearing the weight of the body in an improper direction.

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[1] Constitutional, medical, and dietetic treatment, exercises, gymnastics, inunctions, etc.

[1] See the history of division of tendons, in a Treatise on Club-foot and analogous Distortions, by the author. London, 1853.

[2] See On the Deformities of the Human Frame, by W. J. Little, pp. 271 et seq. London, 1853.

[3] Dissertatio inauguralis de Talipede Varo, Berlin, 1837.

The departure from the normal form and relation of bones may be divided into—

1. Primary.
   - *a.* The changes especially affecting the tibio-tarsal joint.
   - *b.* The change of relation of the anterior bones of the tarsus, as regards the astragalus and os calcis.
2. Secondary, or those induced after birth, by spontaneous aggravation of the deformity, and by pressure upon the parts through walking in an improper manner.

[Mr. William Adams has clearly demonstrated that in club-foot, even in infantile and fœtal specimens, a decided malformation of the astragalus takes place. He finds that the fœtal astragalus presents all the essential changes in form observable in the adult, and hence all the changes found in the bones in the dissection of well-developed club-foot are not the result of "spontaneous aggravation of the deformity." He therefore finds himself unable to confirm the opinion of Dr. Little in regard to the "immaterial changes which the bones undergo previously to the use of the part."[1]

Mr. Adams found that the neck of the astragalus, instead of being continued directly forward as in the healthy bone, inclines abruptly inward, forming an obtuse angle with the body of the bone. The articular head of the astragalus has an antero-lateral aspect. In severe cases the articular surface is divided into two facets separated by a ridge; the one articulates with the displaced navicular bone, and the other is uncovered. The other bones of the tarsus, according to Mr. Adams's dissections of fœtal distortions, are not altered materially in form, although their position is abnormal, and nothing unusual is found in the size or position of the malleolus.

Kocher, however, found, in a dissection of a specimen of congenital talipes varus in an infant, alteration in form of all the bones and joints of the tarsus.[2]]

The anatomical changes of bones in varus of practical moment are due to the state of extension of the os calcis, taking with it the astragalus, through which the posterior extremity of the os calcis is more or less closely approximated to the posterior surface of the ankle-joint; and the anterior portions of the articulating surfaces of the trochlea of the astragalus are projected from the ankle-joint in front. Owing also to the forced inversion of the entire foot, the external malleolus is thrown backwards towards the posterior tuberosity of the os calcis, and the anterior extremity of the astragalus slightly inclines towards the inner margin of the foot. The forced elevation of the posterior part of the foot (calcaneum and astragalus) is common to talipes varus and to talipes equinus; but the characteristic peculiarity of varus is the displacement of the remaining bones of the tarsus inwardly to the extent that the navicular bone quits the astragalus, often touching the internal malleolus, with which it frequently acquires a new articulating surface. The cuneiform and cuboid bones accompany the navicular. Moreover, in severe cases the cuneiform, cuboid, and metatarsals, with the phalanges, are drawn backwards, limiting the space of the plantar region.

The changes of bones induced by im-

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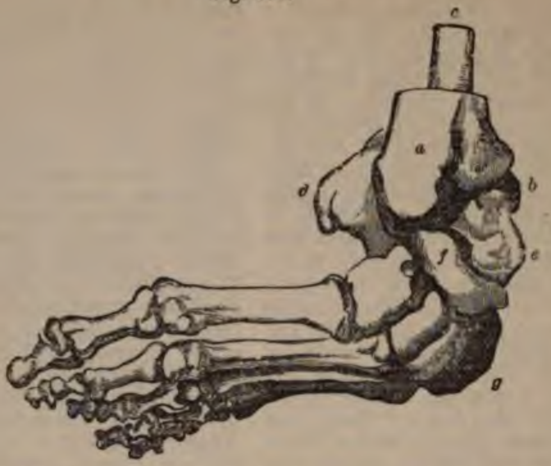
[1] Medical Times and Gazette, 1852; Transactions of Path. Soc., 1856.

[2] Treatise on Club-foot and analogous Distortions, London, 1839. A large number of treatises on club-foot have appeared since 1837, few of which contain any fundamental researches into the anatomy of varus.

[[1] Club-foot, Wm. Adams, 2d edition, p. 149.]

[[2] Deutsche Zeitschrift f. Chir., 9th Bd., 3d and 4th Heft, p. 329.]

Fig. 690.



Severe adult congenital Varus, viewed from the front and outer side; *a*, the tibia, cut down in order to show the relatively posterior situation of the fibula; *b*, the external malleolus; *c*, the fibula; *d*, the posterior extremity of the os calcis, drawn abnormally inwards; *e*, the astragalus, unduly prominent on the dorsum of the foot; *f*, the navicular bone in contact with the internal malleolus; *g*, the cuboid, its proper superior surface applied to the ground.

proper walking, improper pressure and bearing against the ground, by which also sometimes inflammation and ulceration of soft parts are occasioned, do not properly belong to simple uncomplicated club-foot. Only when these injuries are considerable do they affect the results of treatment.

The shortening of the ligaments, fasciæ, and integuments on the posterior and internal aspects of the member may be observed when, before or after operation, attempts are made with the hand to rectify the deformity. In severe cases, much resistance to cure is offered by the posterior ligament of the ankle, the deltoid, the calcaneo-scaphoid, the superficial and deep plantar ligaments. The share of resistance offered by the deltoid, for example, is well shown when dissecting severe infantile varus. After removal of the superficial textures (integuments, fasciæ, muscles, and tendons), much amelioration of shape results; but the ligaments of the ankle being intact, it is observed that the foot still retains a varus form. But when the deltoid ligament is severed, and the navicular bone is liberated, a marked facility of replacement is evinced.

The general direction of the structures involved in the distortion is much altered. Thus, the leg-bones are inwardly rotated from the knee-joint. The surgeon should not expect to find the tendons occupying their normal relations. Those passing over the front of the ankle-joint are deflected inwardly, whilst the posterior tibial tendon appears more deeply situated, owing to the incurvation, and to the backward dragging, and elevation of the anterior part of the foot.

[The dynamic theory of the causation of club-foot, is one which latterly has been subjected to a good deal of criticism, chiefly by German authorities.[1]

It may be said that the greater weight of German authority on this subject is in favor of the theory that ordinary congenital club-foot is due to abnormal intra-uterine pressure occurring during the earlier months of pregnancy. The arguments to support this view are based chiefly upon the fact that dissections of congenital club-foot give evidence of a change of shape in the bones of the tarsus which it is deemed are more likely to occur from unusual pressure than from muscular action of undeveloped muscles. Kocher believes that club-foot is the result of external pressure affecting the foot as a whole, and not a primary change in a single bone. He found after dissection that all the joints and bones of the tarsus of congenital club-foot suffer alteration in form. This external pressure is supposed to begin in the first half of pregnancy before the formation of a joint.

It is undoubtedly true that club-foot often coexists with derangement of the nervous centres, as in acephalous fœtuses, etc., but it does not follow that the latter must be regarded as a cause of the former, and not the result of a common cause. That certain distortions of the feet may arise from a spastic condition of certain muscles is beyond question, but it cannot be regarded as so evident that the ordinary talipes varus originating early in gestation, when it may be supposed that nervous derangements would be of little influence, must necessarily be due to muscular spasm. It is certainly as easy to explain the fact of unilateral deformity on the theory of pressure as upon that of central nervous derangement. And while it is true that amniotic fluid is normally in abundance during the early months of gestation, it is not known to be always so. Acquired club-foot resembles congenital club-foot in a degree, but acquired deformity or any deformity resulting from muscular spasm bears little similarity to severe congenital talipes varus in a limb not used. It is also probable that acquired club-foot following infantile paralysis is not the result of muscular spasm and the direct effect of a disturbance of the muscular balance, but rather to the action of gravity, unusual posture, or abnormally distributed weight upon an enfeebled limb.[1] It is moreover difficult to explain fully on the supposition of the dynamic theory the distortion of the whole limb seen in congenital talipes varus of a severe type (p. 334).

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[1] [Kocher, Deutsche Zeitschrift f. Chir., 9th Bd., 3d and 4th Heft, p. 329.]

Neither theory is satisfactory, and for the solution of the question we must await future investigations.]

Etiology of congenital club-foot.—The primary cause of talipes varus congenitus has been already touched upon, p. 328. It consists in an alteration of the dynamic properties of certain muscles, apt to be accompanied or followed by structural shortening,[2] and by fibrous and adipose degeneration of them.[3] Until the researches of Rudolphi, it was held that club-foot, as well as other distortions and malformations, were the consequence of some "occult influences," lusus naturæ, maternal imagination, and intra-uterine pressure. An occasional effort is made to revive the last of these theories, that of intra-uterine pressure. It has been elsewhere shown[4] that accidental mechanical causes do sometimes act upon the fœtus, giving rise to easily recognizable conditions, *e. g.*, fissures, clefts, intra-uterine fractures, amputations of members from constriction by abnormal bands or by the umbilical cord; and sometimes the co-operation of pressure by the uterine walls and pelvic bones may be surmised.

The arguments in favor of the belief that ordinary congenital club-foot is caused by some derangement of the cerebro-spinal centres and dependent nerves, as opposed to the theory of its dependence upon pressure of the walls of the uterus, may be thus stated:—

Club-foot often co-exists with evident derangement of the nervous centres, as in acephalous, hemicephalous, and spina bifida subjects.

Club-foot occasionally co-exists with an analogous distortion of the upper extremity, club-hand, in which the muscles contracted are the anatomical analogues of the parts contracted in the lower limbs. Now if it be admitted that the external configuration of double club-foot may suggest to the unphysiological and unpathological observer the idea of one of the feet having overlapped the other in such manner that the uterus, *supposing* the liquor amnii to be deficient, has compressed the two feet into the form in which we see them, this explanation does not apply to the club-hands, which bear no such form as can be reasonably attributed to pressure of the uterine walls. Moreover, club-foot often exists in one foot only, and the uterine-pressure theory does not explain why one foot escapes. This theory is still less applicable to the highest grade of club-foot, in which the great toe is more approximated to the inside of the leg than pressure of the uterus will explain; whilst the opinion of undue (spastic) action of the muscles before the articulating ends of bones can restrict their action, affords an intelligible explanation.

Club-foot is met with in fœtuses before the fourth or fifth month of gestation, at which period the liquor amnii is relatively so large as to exclude the idea of uterine pressure consequent upon *supposed* deficiency of that fluid.

Congenital club-foot can often be traced to hereditary influence, sometimes on the father's side, sometimes on the mother's side. We have traced it on the paternal side even through four generations, the male infant, the father, the grandfather, and the great-grandfather. If it can be plausibly maintained that club-foot is due to the influence of uterine pressure, deficiency of liquor amnii, pressure of pelvic bones, and its repetition through successive generations, this influence could only be propagated through the female side. We cannot admit uterine influence in hereditary propagation of varus through an uninterrupted succession of male parents.

A comparison of club-foot with the distortions which occur after birth, unmistakably from diseases of the nervous system, tends to prove that congenital and non-congenital club-foot spring from analogous causes. Distortion after birth, from altered innervation of muscles, is more common in the lower extremities, and especially in the feet, than in any other part of the frame. Club-foot is also the most common distortion before birth. After birth, talipes varus, in consequence

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[[1] Volkmann, Klinische Vorträge, I.]

[2] Little, loc. cit.

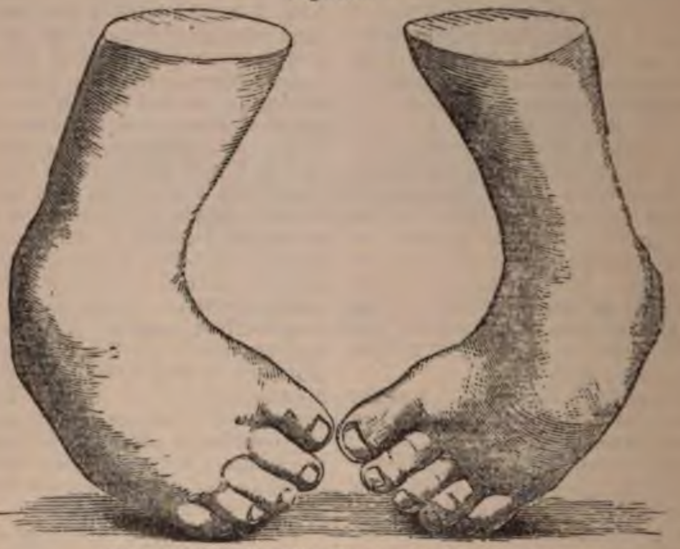
[3] Cruveilhier, Anat. Pathologique; W. Adams, Pathol. Trans., loc. cit.

[4] On Deformities of the Human Frame, pp. 256-314.

of cerebro-spinal affection, is more common than talipes valgus; before birth also, varus is more common than valgus. After birth, foot-deformity, from disease of the nervous system, attains often a higher grade on the left than on the right side. This is equally the case with congenital club-foot. Some other agency than accidental uterine or pelvic pressure is required to account for these analogies; they cannot be regarded as mere coincidences.

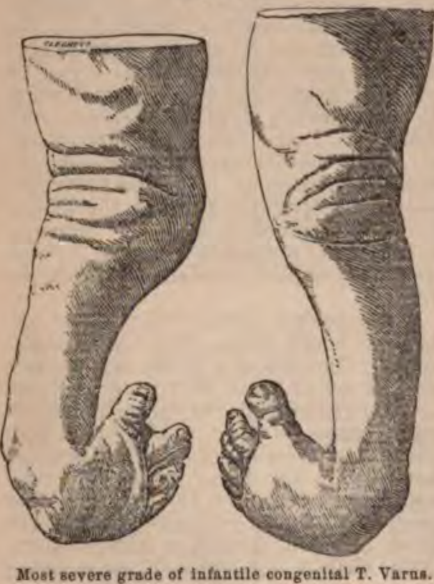
Grades of congenital talipes varus.—It is convenient for practical purposes to divide congenital club-foot into three degrees of severity: the slightest, that in which the position of the front of the foot when inverted is such that the angle formed by it with the inside of the leg is greater than a right angle, and in which the contraction is so moderate that the toes can easily be brought temporarily by the hand of the surgeon into a straight line with the leg, and the heel be depressed to the natural position. The second class includes those in which the inversion of the foot and elevation of the heel appear the same or little greater than in those of the first class, but in which no reasonable effort of the surgeon's hands will temporarily extinguish the contraction and deformity. The third class comprises those in which the contraction of soft parts and displacement of hard parts reaches the highest degree, so that the inner margin of the foot is situated at an acute angle with the inside of the leg, sometimes is even almost in contact with it.

Fig. 691.



Congenital infantile Talipes Varus, of medium severity.

Fig. 692.



Most severe grade of infantile congenital T. Varus.

Cases of the first and second grades may be respectively converted into the second and third grades by delay in the application of remedies, and by the effects of improper locomotion.

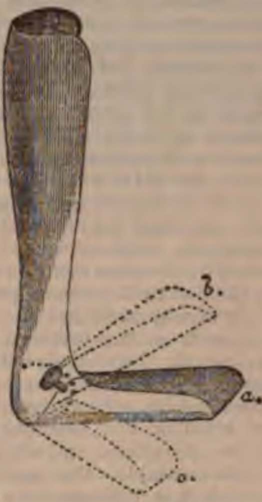
[Scarpa, believing that in club-foot no deformity of the astragalus was to be found, except such as would be developed by the persistence of the deformity, based his idea of treatment upon this fact; and tenotomy was necessarily regarded as the chief agent in effecting a cure. The introduction of tenotomy was certainly a great step in advance in the treatment of club-foot, but its general use has given rise to a belief that proper section of the tendons with means to restore the proper balance of the muscles sufficed to cure club-foot. This has led to numerous failures, or but partial successes, and even to a wholesale denunciation of tenotomy.

Club-foot is now to be regarded as a distortion brought about by a change in almost all the tissues around the mediotarsal joint, and a change in the shape of the astragalus. Treatment consists not only in overcoming the shortening of the muscles, ligaments, fasciæ, etc., on the contracted side of the member, bringing the bones into their proper position, and strengthening the weakened muscles—but also in preventing relapse until the shape of the astragalus and its relation to the scaphoid becomes sufficiently normal to make a relapse impossible. This is clearly shown by a dissection of Mr. Adams of the foot of a child six years old. Talipes equino-varus had been successfully treated by Mr. Lonsdale, and the foot had been brought into nearly a normal position. On examination after death it was found that marked obliquity of the neck of the astragalus still remained. As the growth of bone is quite rapid in the first year of life, its treatment should be begun as early as possible. There can be no question of the advantages of tenotomy, and the objections urged against its use[1] do not seem well grounded; but this procedure must be regarded as a means to aid in placing the foot in a normal position, but not as alone capable of a cure.]

Treatment.—The indications are to overcome the shortening of the muscles, ligaments, fasciæ, and integuments on the contracted side of the member; to direct the bones into their proper position; to educate the patient's voluntary use of the parts; to give strength to the muscles and ligaments on the elongated side of the member, and to combat the tendency to relapse.

A few slight cases may from the day of birth almost be relinquished to the rubbings and manipulations of the nurse; some require to be lightly bandaged on a strip of tin or firmer metal, bent to a right angle, and properly padded; others require support not only beneath the sole, and against the back of the leg, as when a simple bent strip of metal is employed, but need lateral support or pressure against the internal margin of the foot, as by the application of a tin splint devised by the author (see fig. 693). In the use of this and similar contrivances to be found at the different surgical instrument-makers', the essential point consists in applying the smallest amount of pressure compatible with maintaining the apparatus on the limb, not endeavoring at once either to force the part straight or even to make the tender infantile foot accurately fit the apparatus, but rather, if the apparatus selected admits of adaptation, to adjust it to the foot in a somewhat improved position. Practitioners unacquainted with the details of management of these cases are surprised to discover how small an amount of pressure suffices in young infants rapidly to improve the form and flexibility. The splint should daily once, or oftener, be removed to ascertain that undue pressure has not been used, to replace it when loosened by the movements of the child, and to improve the position as often as practicable. No unnecessary loss of time should be permitted during this process, as at first the foot rapidly relapses to its most distorted condition.

Fig. 693.



[Mr. Barwell has advocated a system of the treatment of club-foot by means of artificial "rubber muscles," with the object of supplying the strength of the weakened muscles by rubber cords which are arranged as far as possible to exert traction in the direction of the normal muscles. The upper attachment of the "rubber muscle" is that given by securing it to a plate which is fastened to the limb by adhesive plaster, the lower attachment is to the foot, to which adhesive plaster is applied.[1] It is perfectly true that congenital club-foot can be corrected in this way without having recourse to tenotomy, and it is also true that the contraction can be overcome in an uncomplicated case of club-foot as thoroughly in this way as by tenotomy. Tenotomy, however, has no especial disadvantages which have been satisfactorily demonstrated.]

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[1] Barwell on Club-foot.]

[1] Barwell, Club-foot; Sayre, Club-foot.]

If at the expiration of the fourth week distinct contraction of the tendons remain perceptible in spite of assiduous efforts to overcome the deformity by manipulations, frictions, and steady but gentle employment of splint and bandage, or if benefit proportionate to the attention bestowed be not realized, or if the case unequivocally belongs to the second or third degrees of varus, the aid of tenotomy will be required to effect restoration. If the surgeon should entertain doubt whether the time for operation have arrived, he may be determined by the observation whether, on holding the foot in the normal position, it springs vigorously back into the abnormal one as soon as the pressure of the hands is removed. In unequivocal cases of the second and third degrees he may, in most cases, decide affirmatively at the moment of birth on the absolute necessity of future operation; and when operation is indispensable, the earlier the period at which it is performed the better. Mr. Stromeyer Little has operated within twenty-four hours after birth with rapid and permanent success. Our practice of late years has been to operate as soon as convenient during "the month." The surgeon, when deciding on the necessity of operation, must not be guided solely by the external configuration, but by the amount of firm resistance opposed to restoration, by the depth of the furrows existing in the sole and behind and above the heel, and by the degree of tension of the integuments about the internal malleolus. The deep clefts or furrows in question denote intensity of contraction of muscles, and closer adhesion than usual of integuments and fasciæ to the subjacent soft structures and bones. They probably denote also that the deformity dates from an early period of uterine existence. Even atrophy, the usual concomitant of contractions of long duration, is already present in severe club-foot of new-born children, and is a measure of the length of time the muscles have been contracted and exposed to structural shortening and possible degeneration.

Nature of the operation.—The essential character of congenital talipes varus being a state of abnormal elevation of the heel, and inversion of the front part of the foot by undue muscular contraction, the operative interference required consists of the division of the tendons of those muscles which are mainly, if not exclusively, concerned in the production of the deformity, viz. the tendons of the anterior and posterior tibials, and the tendo Achillis. In average cases these three tendons may be divided at one operation. In severer cases the operation should invariably be divided into two parts, the first consisting of the section of those structures which contribute to the inversion—the tibiales tendons; and where the sole is much contracted with a strong prominent band felt at the inner edge of the plantar fascia, that band may be included in this portion of the operation. The division of the plantar textures and elongation of the sole may in severe cases advantageously precede the section of other structures. The tendo Achillis may in such cases be severed in three or four weeks; in adults, two or four months later; the inversion having, in the interval, been overcome. The value of this proceeding, first recommended by the author,[1] consists in the os calcis, when the tendo Achillis is left intact, offering a *point d'appui*, or resisting point, from which the surgeon, during the mechanical after-treatment, is enabled to stretch out and unfold the contracted involuted sole. If this division of the operation into two or three parts is not observed in bad cases, incomplete recovery may result, the sole remain contracted, and the individual walk unduly on the heel, the range of motion of the point of the foot being deficient—in short, a secondary talipes calcaneus be produced. This secondary deformity is always overcome with difficulty, sometimes it is irremovable.

In a few adolescent and neglected adult cases of congenital equinus and varus, even the peronei may need division, these muscles having become, from protracted duration of the deformity, tensely contracted and considerably shortened.

The following is the mode of dividing some of these tendons, and the instruments which we have introduced as the most appropriate for the purpose. The operation is more quickly and more conveniently done by taking the three tendons in the following order, viz., the posterior tibial, the anterior tibial, and the tendo Achillis. Section of the posterior tibial is best performed by placing the child on a table of convenient height, on its back, inclined towards the limb to be operated on. This should be thoroughly rotated outwardly, resting upon its outer side, whilst a competent nurse holds the child's hands and the opposite leg out of the way of the surgeon. An assistant, having a small dossil of lint, a bandage, and the necessary knives within reach, takes his place by the side of the patient, and holds the thigh and knee of the limb to be operated on with one hand, being prepared with the other to hold firmly or adduct the foot, as may be required. The operator, when about to sever the left posterior tibial, seats himself in front, takes the foot in his left hand, and endeavors to feel the slight prominence of the posterior tibial tendon with the left thumb; during the time he either abducts the foot with the right, to put the tendon on the stretch, or takes advantage, during the spontaneous movements of the infant, to observe where the tendon is drawn into palpable relief.

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[1] Lancet, May 25, 1839.

When, however, the surgeon cannot feel the tendon, it is practically quite sufficient to make out the inner edge of the tibia, about a finger's breadth above the lower end of the inner malleolus; or should there be any difficulty in defining this ridge of bone in consequence of the fatness of the limb, the careful insertion of the knife *exactly midway between the anterior and posterior borders of the leg*, on its inner aspect, will be an exact guide to the position of the tendon, not forgetting, as anatomy teaches us, that an incision made a little in front of this line might wound the internal saphena vein and nerve; and if made behind it, would run the risk of dividing the flexor communis digitorum instead of the tibialis posticus; or the knife might even pass posterior to the former tendon, and, if carried deep enough, might wound the artery and nerve without touching any tendon whatever.

Having thus determined the situation of the posterior tibial by one or all of these methods, a sharp-pointed knife is passed through the skin at about a finger's breadth above the inner malleolus, according to the age of the child. It must be made to penetrate steadily down, *perpendicularly to the surface*, to a depth varying from a quarter to half an inch. In doing this, it is necessary to be quite sure of sufficiently opening the fascia covering the posterior tibial and common flexor tendons; otherwise, when the probe-pointed knife is passed in (as will be described in the next stage of the operation), it may either hitch against this dense unyielding structure, or glide over its surface behind the deep layer of muscles, instead of passing through the opening in front of them.

In order, therefore, to accomplish the *free division* of this fascia of the leg close to its insertion into the edge of the tibia, and likewise the proper sheath of the posterior tibial tendon beneath, the sharp-pointed knife should be passed to the depth above recommended; the handle must then be elevated so as to depress the point of the blade; that is to say, the instrument should be used as a delicate lever, the centre of motion being the skin, which may be pressed upon gently by the back of the knife; and in this way an opening of the requisite size can be made in the fascia at the bottom of the wound, without enlarging the external aperture.

Having thus far accomplished the operation, the sharp-pointed knife is withdrawn, and a probe-pointed one is to be passed into the puncture through the skin, superficial fascia, layer of adipose tissue, deep fascia, and lastly the proper sheath of the tendon, and be now inserted a little further in, so as to get well between the posterior tibial and the tibia. When satisfied from the sensation communicated to the knife that the bone is on one side and the tendon on the other, all that remains to be done is to turn the edge towards the tendon, giving the knife a slight cutting motion, while at the same time the assistant firmly abducts and depresses the inner border of the foot.[1]

A distinct sensation of something having suddenly yielded can be perceived at the time of the division of the tendon; but if the case should have been previously operated on, this feeling may be very slight, in consequence of the adhesions existing between the original wound of the tendon and the adjacent parts.

As soon as this peculiar jerk is detected by the assistant, he should immediately relax the foot, and apply a dossil of lint over the wound, holding it there with the fore-finger during the division of any other tendons. If, as has happened, the artery is supposed to be cut, either from the escape of florid blood or from the blanched appearance and reduced temperature of the foot, it will only be necessary to apply instantly a graduated compress, and to roll firmly a bandage upon the foot and ankle. This, however, may require to be loosened if the color of the toes shows any indication of strangulation. If the operator is not ambidexter, he will find, in the operation for dividing the posterior tibial tendon of the right limb, that he had better stand on the left side of the patient with his back to the patient's face, whilst the assistant sits down in front, and holds the thigh with one hand while he steadies the toes with the other.

Taking, then, the mesial line of the inner aspect of the leg at about three-quarters of an inch above the inner malleolus as the true position of the tendon, the sharp-pointed knife is to be inserted perpendicularly, with its back towards the sole of the foot. It is thus made to divide the skin and deep fascia in the same way as was explained when cutting the left posterior tibial tendon. After this instrument is withdrawn, the probe-pointed knife may now be used to finish the operation, which in all other respects agrees with the section of the corresponding tendon on the opposite side of the body. The long flexor of the toes, owing to its proximity, is often partially or wholly severed at this operation on the posterior tibial.

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[1] We have seen more than one straight sharp-pointed bistouri caché used instead of two separate knives. The best of these was in the hands of Dr. Dick.

Weis and Velpeau divide the posterior tibial tendon at its insertion into the navicular bone, the knife being inserted so as to meet the tendon about an inch (in the adult) below and in front of the inner malleolus. This plan is inapplicable to infants. In adolescents and adults this tendon is usually so prominent to the eye and touch above and behind the internal malleolus, that it is an easy matter to sever it by inserting the point of a narrow straight scalpel at the posterior edge of the tendon, directing it forwards between the tendon and tibia, so as to divide it without risk of injury to the posterior tibial artery or the internal saphena vein. It is unnecessary to give particular directions for division of the plantar fascia when needed, those given respecting operations on other tendons being amply sufficient. The direction of the knife should be from without inwards, *i. e.*, from the external margin of the foot towards the internal margin.

The division of the anterior tibial tendon in talipes varus should follow the section of the posterior tibial; the patient being in the same position, and the assistant still holding the limb, and pressing his finger upon the lint covering the puncture already made above the ankle. The operator should feel for the most prominent part of the tendon over the joint, somewhat nearer the malleolus than in the normal foot, and insert a sharp-pointed knife, with its flat surface towards the outer edge of the tendon; and having passed it well beneath, he should turn the sharp edge towards the tendon, whilst the fore-finger of the left hand is pressed gently over the part, to warn him of the approach of the knife to the surface. The assistant, who has been steadily abducting the foot during the operation, gradually relaxes his endeavors as he feels the tendon yield; and as soon as he perceives the distinct snap which is the result of its complete division, he should immediately relax his hold, and apply a small dossil of lint over the puncture.

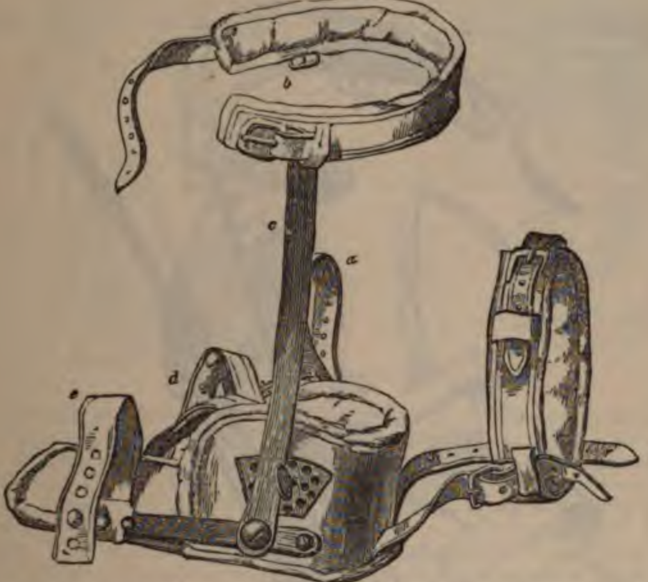
Division of the tendo Achillis is accomplished after turning the infant over on the abdomen. Whilst an assistant endeavors to bend the ankle, the surgeon introduces a small straight tenotome through the integuments from behind forwards at the side of the tendon. As soon as the point of the instrument is judged to have reached the anterior surface of the tendon, it is passed in front of it; the cutting edge is then directed to the tendon, severing the tense cord by one or two movements of the blade against it, and without wounding the integuments, except by the puncture of entry. The assistant should carefully relax the pressure he may be exercising upon the foot in proportion as he feels the part is cut through.

These operations, when properly done, occupy not more than a few seconds each, and are usually absolutely bloodless. Much has been written concerning the danger of wounding the posterior tibial artery. I have only once witnessed any trouble from the circumstance. This accident occurred to a former colleague. Ligature of the vessel on account of a small filbert-sized aneurism was required the third week after the operation. In that instance the wound in the vessel would have probably healed without aneurism if the surgeon had not too soon after the accident incautiously removed the bandage and abducted the foot. When injury of the vessel is suspected or known to have occurred, the removal of the bandage and commencement of the mechanical after-treatment should be delayed three weeks.

A pasteboard or soft metal splint, previously moulded to the form of the contracted part, should be employed immediately after the operation, to ensure quiet, and favor healing of the punctures.

Apparatus required after operation.—The metal splints already recommended for cases relievable without operation are equally applicable after division of tendons. Three days after operation, one of these splints, not much straighter than the affected foot, should be selected, or if a splint capable of being adjusted by a screw be used (fig. 693), it should be set at an angle or in a direction that the child will bear without complaint. In infants above the age of two or three months, a more elaborate and effective apparatus may be employed, when the pecuniary circumstances of the parents permit it. The woodcut, fig. 694, represents the lighest, the most effective, and the most inexpensive of the more elaborate apparatus constructed for the purpose. The perpendicular lever and the toe-spring are derived from Scarpa's shoe; but as Scarpa's apparatus contains no contrivance for depressing the heel, but relies simply on the effect of the weight of the body acting during locomotion, the author has introduced the movable thumb-screw, capable of being inserted into any required hole of the quadrant shown as above. This is an improvement upon the male and female screw, and the double acting ratchet-screws often used for the purpose. The simple arrangement of a movable thumb-screw has, in addition to lightness, the advantage of permitting mobility of the ankle in the direction of bending—a circumstance of much importance.

Fig. 694.



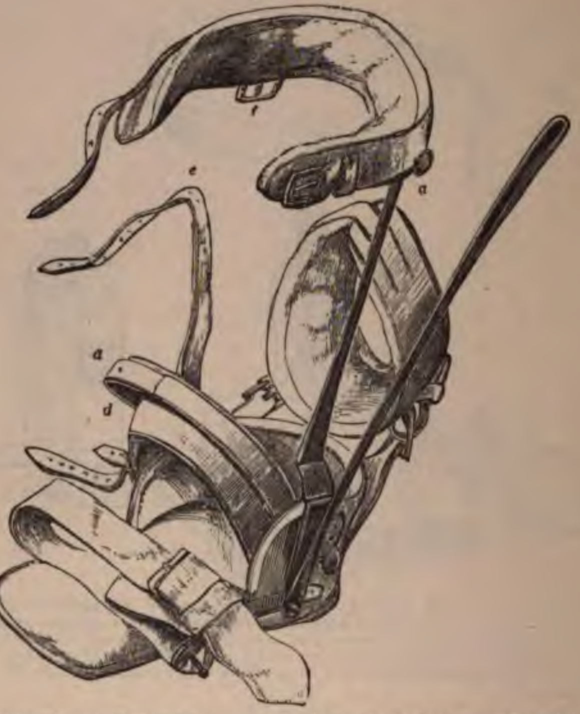
Dr. Little's Shoe for varus of left foot:—*a*, strap to be attached to the buckle *b*, intended to moderate the action of the lever-spring *c*; *d*, two straps which start from within the heel-piece on the outer side of the foot near the sole-piece, and are intended to be secured to buckles on the opposite side of the instrument, for the purpose of holding the posterior part of the foot firmly against the inside of the shoe, whilst the strap *e*, and short spring to which it is attached, draw the front of the foot outwardly. The convalescent may take exercise in this apparatus.

Cases of the first grade of infantile deformity are usually rectified in two or three weeks, those of the second grade in about four weeks, and those of the highest grade, the operation and the mechanical treatment having been divided into two or three stages, within two or three months. The treatment of adolescents and adults varies from two to twelve months.

Relapse not rarely occurs after the most complete flexion and abduction has been obtained. It takes place insensibly, at all ages, especially when growth is most rapid, and is due to too early discontinuance of instruments, and to neglect of manipulations, and of passive and active exercises. The worst so-called relapses result from previous incompleteness of operation or of restoration. No case should be considered finally cured until the mental development of the patient is sufficiently advanced for him to take an interest in his cure, and to be able voluntarily to hold the part in a perfect position, and perform the natural movements of it. In relapsed cases repetition of tenotomy is not commonly required. Often the *tendons* will be found of ample length; sometimes the diminutive belly of the gastrocnemius, for example, wasted through want of the stimulus of adequate alternate flexion and extension—*i. e.*, proper exercise — being shortened and drawn up towards the popliteal region. A common cause of relapse is doubtless the previous insufficient curative elongation of the fasciæ, ligaments, and muscles situated on the contracted side of the member, and is favored by the corresponding relaxation and weakness of structures on the opposite side. Continuous gentle re-application of the extending apparatus, aided, as soon as flexion to the right angle is reached, by exercise with a wedge of cork beneath the front of the sole, suffices to restore these cases usually within a few weeks—*i. e.*, within the period the patient would have been required to lie up if tenotomy had been repeated. It is satisfactory to be able, not only to spare the patient and friends the concern incidental to any operation, but to be able to avert, by mechanical means only, without loss of time, the discredit which attaches to the repetition of the operation.

In the treatment of relapsed adolescents, an apparatus that will bear the risks of walking exercise, and at the same time favor mobility of the ankle-joint in the required direction, is afforded by fig. 695.

Fig. 695.



Dr. Little's double-hinged upright Shoe for severe rigid Varus of left foot: *a*, stiff upright, hinged in two places, which when applied to the leg adapts itself to any degree of deformity; *b*, a spring curved outwardly, which when brought into contact with *a* can be then secured by means of a swivel-stud; *d d*, two straps for purposes similar to straps *d*, in last figure; *e*, moderating-strap, to be secured to *f*, as required. If the act of bringing the spring *b* into contact with *a* should occasion too much strain, *b* can be fastened at any required distance from *a*, by means of a tape. In the application of a varus shoe, success depends much upon the nicety with which the shoe is applied to the sole-plate of the apparatus, and upon careful adjustment of the power employed. The foot-part of the shoe should be properly applied before the upright lever is secured. The moderating-strap is the last to be fastened.

After operation for club-foot, even in infants, continuous application of splints or other apparatus is required for four or five weeks; in older children, for two or three months. The less severe the case, the more often the apparatus may be removed for cleanliness, and to examine lest undue pressure is employed. It is the boast of successful treatment of club-foot to be able to accomplish this result without a single excoriation. The surgeon should watch that, in his efforts to depress the heel and abduct the foot, the part be not too long maintained in one position, to the extent that the power of lowering the toes and of inverting the foot is lost; or, in other words, a valgus be engendered in exchange for the varus. This secondary valgus has been attributed to the non-union of the severed posterior tibial tendon. It is really due to too long-continued retention of the foot in an abducting apparatus. We have witnessed it in children born with varus, who had been treated without operation. Its production is favored by the same constitutional debility which produces spurious valgus, or flat-foot, in rapidly-growing children, who have previously had perfect feet.

Instrumental treatment is further required during at least a portion of each twenty-four hours, until the individual is enabled to plant the entire sole evenly and properly upon the ground, to thoroughly flex and extend the part at will, and habitually, when walking properly, to evert the toes. In numerous cases a child requires no apparatus after the age of five or six months; but the majority need some instrumental aid, such as leg-irons, to evert the entire extremity until the intelligence is sufficiently awakened—say, until the age of three years. The maintenance of the "cure" depends, as in all diseases, greatly, if not mainly, upon the individual or his natural guardian. We have had cases under observation off and on from infancy to puberty, owing to successive relapses, which have more commonly occurred abroad or in the colonies. We have witnessed examples of adults returning to be re-operated on, who have been successfully referred to their own efforts, with a few instructions as to mechanical attention.

Fig. 696.

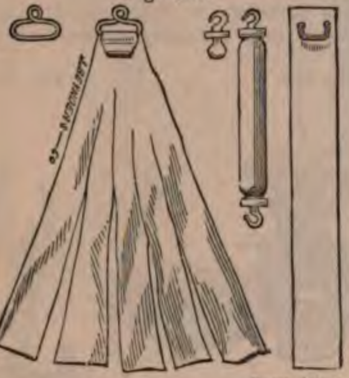
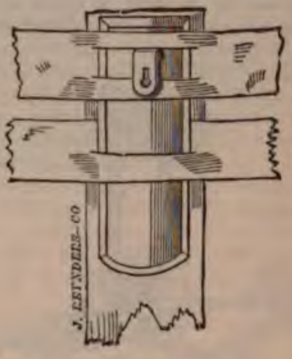


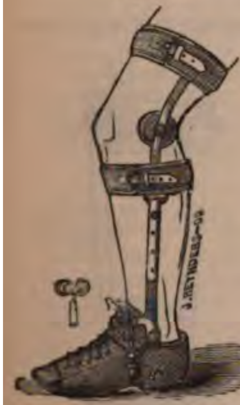
Fig. 697.



Barwell's appliances for club-foot.

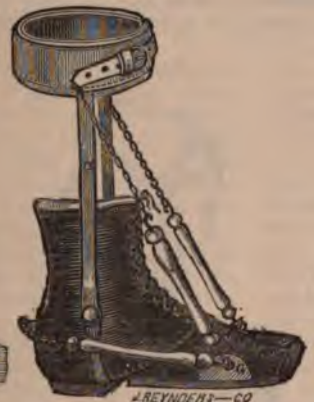
[Surgeons are divided in their opinions as to the advisability of delaying replacement after tenotomy. English authorities have followed the teachings of Delpech and Stromeyer, and do not favor immediate extension. In this they are supported by many American surgeons, but opposed by Mr. Syme, of Edinburgh, Dr. Gross, of Philadelphia, and Dr. Sayre, of New York.[1] Dr. Buckminster Brown, of Boston, expresses himself strongly in favor of immediate extension in non-paralytic congenital varus, arguing that no risk is run in extending immediately, as over-extension is prevented by the contraction of the ligaments and fasciæ. After an extensive experience, he reports that he has never met with any bad results from such a practice.[1] This is also the practice of some German surgeons.[2]]

Fig. 698.



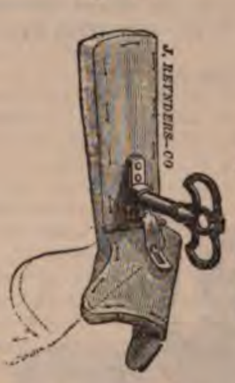
Gross's club-foot shoe.

Fig. 699.



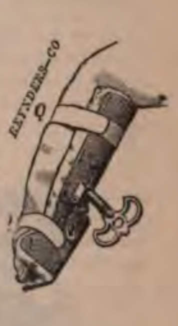
Sayre's club-foot shoe.

Fig. 700.



Shaffer's lateral splint for club-foot.

Fig. 701.



Shaffer's lateral splint applied.

After tenotomy no replacement of the part should be attempted until after the puncture has cicatrized. Much has been written respecting the propriety of immediate replacement. It is unnecessary in slight cases, and impossible in severe ones. In slight cases, nothing is gained by it; for if the position may be immediately rectified, the part cannot be immediately used. The limb should therefore be gradually replaced while the tendon is consolidating itself.

The influence, in interfering with union, of too-considerable and too early separation of the ends of a severed tendon, and especially of frequent motion, as in walking, is incontestable. Experiments upon animals have proved that considerable lengths of tendon may be excised, and union nevertheless ensue; but the knowledge possessed of the great extent of the powers of the economy is an insufficient reason for neglect of those rules of caution which experience dictates. The immediate separation of a severed tendon to too great an extent should be avoided. Half or three-quarters of an inch may be safely borne, although as a rule gradual separation is preferable. The condition of a severed tendon approaches that of a fractured bone; too great separation of the severed ends, depression of temperature sufficient to suspend active arterial circulation, too early movement of the parts, and inherent vice of constitution, may cause tendon, like bone, to remain ununited.

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[1] Club-foot, New York, 1873, p. 38.]

[1] Boston Medical and Surgical Journal, Nov. 20, 1879.]

[2] Kocher, Deutsche Zeitschrift f. Chir., 9th Bd., 3d and 4th Heft, p. 329.]

Fig. 702.

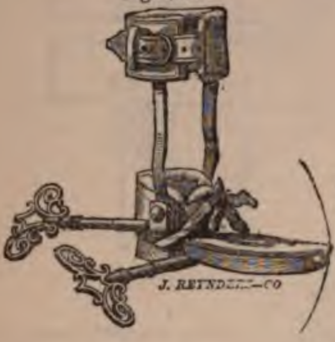


Fig. 703.

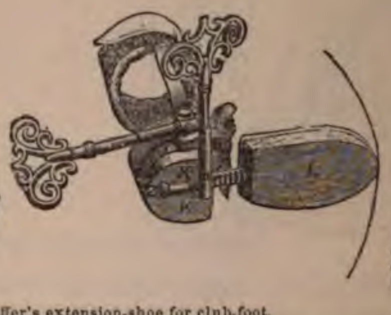
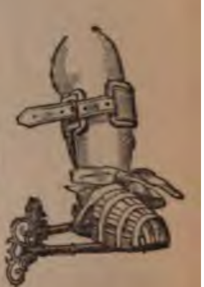


Fig. 704.



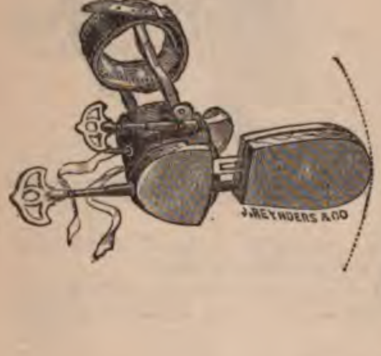
Shaffer's extension-shoe for club-foot.

Stromeyer has suggested, that previously to operation the patient should be accustomed to wear the replacing instrument. This plan is desirable when the practitioner is unfamiliar with the treatment of deformities; for he thereby becomes versed in the action and mode of application of the apparatus, and is rendered certain beforehand of the appropriateness of the contrivance.

[A great variety of appliances have been devised for the treatment of club-foot, and recommended by different surgeons as successful in their experience. A detailed description of these is impossible in this article; their nature, however, will be seen by the accompanying illustrations.

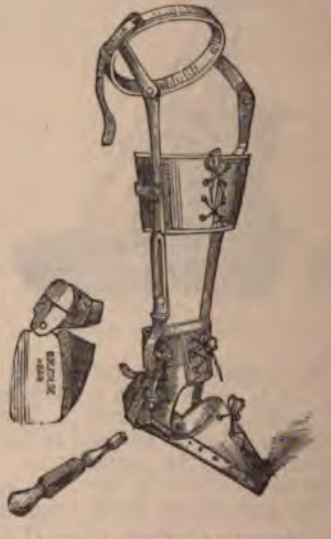
It may be said, however, that whatever

Fig. 705.



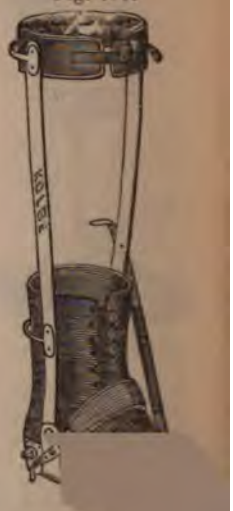
Modification of Shaffer's extension-shoe.

Fig. 706.



Correction apparatus for various forms of club-foot.

Fig. 707.



Club-foot shoe for night use.

appliance may be used, the success of treatment will depend upon the thoroughness with which it is applied.

Fig. 708.

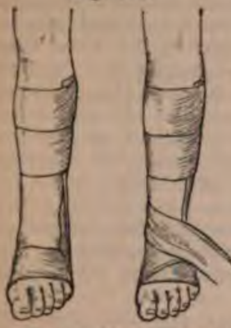


Fig. 709.

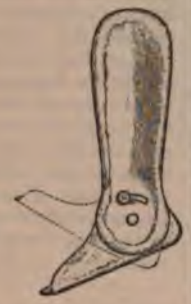
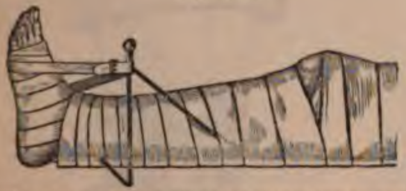


Fig. 708. Mode of stretching the foot in talipes varus by strapping (Bryant).
Fig. 709. Splint for talipes (Bryant).

Fig. 710.



Mr. Davies-Colley's splint for talipes equino-varus (Bryant).

The treatment of club-foot by means of a plaster-of-Paris bandage has been recently again brought to notice, and is useful for a class of patients too poor or to careless to attend to the detail needed in the application of apparatus.

In such cases, excellent results in correcting the deformity can be brought about by plaster bandages, frequently renewed.

After tenotomy has been performed, which should be done, except in the slightest cases, the foot should be bandaged with a soft bandage, and the foot brought into position as far as possible and held during the application of the bandage by means of loops of adhesive plaster, held by an assistant, one being placed over the toes and pulled outward, and the second over the instep and pulled inward. When it is necessary to correct the equinus position, and to rotate the anterior part of the foot, it is necessary for the toes to be held in the proper position while the plaster bandage is applied. The bandage should be renewed in a few days in order to farther correct the deformity, and to prevent the formation of chafes. The danger of this latter is less than would be imagined, if the bandages are applied with care, and by one who is skilled in such procedures. But little more time need be expended than is frequently necessary for the proper adjustment of club-foot shoes. The bandages can be removed and reapplied daily, or frequently can be left untouched for a fortnight. The frequency of renewal should depend upon the need of increased correction of the deformity, and the amount previously gained.

The advantages of this method are that it is inexpensive and fixed, and also free from discomfort to the patient, the bandages being as a rule less uncomfortable than a Scarpa's shoe frequently is.

The chief disadvantage is the clumsiness of the appliance.[1]]

With reference to the choice of the apparatus, Stromeyer has rightly remarked, that every practitioner will select that of which he best understands the action and mode of application. This sagacious observation explains also one cause of the zeal with which each writer advocates his particular appliance.

It cannot be too strongly insisted upon, that in a large number of deformities, whether treated with or without operation, expensive instruments are unnecessary. More depends upon the tact, patience, and perseverance of the practitioner than upon the particular apparatus employed. Common roller bandages, with or without starch and plaster-of-Paris, tin, wood, or gutta-percha splints, aided by manipulations, may, in ingenious hands, supply the place of the most elaborate contrivances.

It may sometimes happen that no instrument is available, and the after-treatment may require to be conducted entirely by manipulations. Thus an adolescent case of double congenital varus was admitted into the London Hospital, under the care of Mr. Critchett, presenting large ulcers with necrosis on the dorsum of each foot, induced by pressure during the mechanical treatment after tenotomy. As the unhealthy character of the ulcers depended upon want of air and exercise, and the application of suitable instruments was impossible, it was determined not to wait for cicatrization of the ulcers, but to repeat tenotomy, and effect forcible manipulations of the members. Chloroform was upon one occasion employed. By these means the feet were gradually straightened, cicatrization of the ulcers was thereby favored, and within three months the lad quitted the hospital entirely restored.

After congenital varus, as after ac-

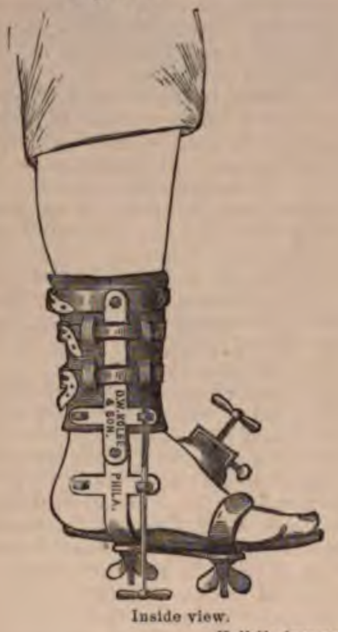
[[1] Ogston, Edinburgh Med. Journal, Dec., 1878, p. 482; Reeves, Med. Times and Gazette, Oct. 25, 1879, p. 475; Hutchison, Orthopedic Surgery, New York, 1880.]

quired deformities, retentive apparatus may be required; these for the most part consist of jointed irons to support the weak articulations, and springs to assist the action of the debilitated muscles.

The completeness of recovery in the great majority of the cases of congenital varus constitutes one of the triumphs of surgical art.

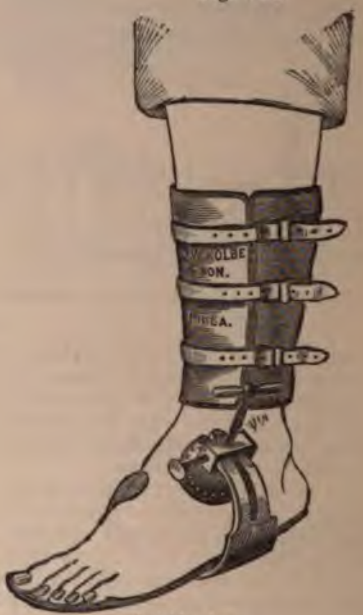
During childhood congenital varus may be entirely cured, without other traces of deformity than smallness of the member, greater squareness of the front of the foot, and sometimes less complete mobility of the ankle-joint, the patient recovering entire volition. When the case is unattended to before adult age, the internal margin of the foot may never be completely applied to the ground, owing to the impossibility in some cases of perfectly unfolding the os cuboides from its inferior and rotated position in the tarsus; in other instances, owing probably to the round head and neck of the astragalus having become so much inverted in relation to the remainder of the bone, that part of the undue convexity of the tarsus outwards becomes irremediable. Every year reduces the number of adult cases of varus requiring treatment, so that the consideration of any means of meeting the attendant difficulties may appear superfluous. The author has usually found a most efficient agent in a firm pad placed in the sole beneath the os cuboides, pressure being at the same time made upon the upper surface of the other tarsal bones.

Fig. 711.



Inside view.

Fig. 712.



Outside view.

Kolbé's improved club-foot stretcher.

[Dr. Benj. Lee, of Philadelphia, has reported the cure of a severe relapsed case of talipes equino-varus, where tenotomy alone and mechanical treatment appeared to be of no avail, by the successive application of force, under an anæsthetic, repeated every third day for three weeks; the subsequent employment of apparatus completed the cure;[1] he has also used a Morton "club-foot stretcher"[2] after tenotomy, to advantage.

Operative interference in old relapsed cases, by removal of pieces of bone from the tarsus, was suggested first by Mr. Little, and first performed by Mr. Solly, who excised the cuboid, at St. Thomas's Hospital, in 1854, and with an improvement, but not a perfect success.[1]

Mr. Lund subsequently removed with success the astragalus, to a large extent correcting the deformity, but not leaving a perfect foot.[2]

This operation has been successfully

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[1] Transactions of the American Med. Association, vol. ix., 1868.]

[2] Phila. Med. Times, Oct. 9, 1880, p. 25.]

[1] Adams, Club-foot, 2d edition, p. 251.]

[2] Lancet, March 16, 1878, p. 389; Fisher, Lancet, vol. i., 1878, p. 553.]

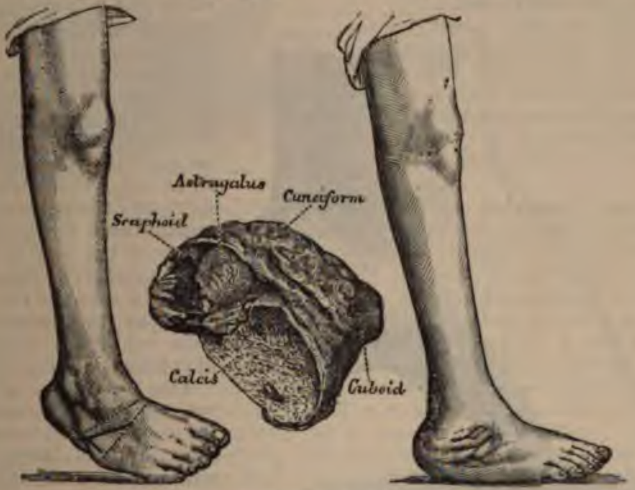
repeated by Mr. Lund himself,[1] Mr. Thomas Smith and Mr. John Wood.[2]

Dr. Mason, of New York, was unsuccessful in attempting to cure a deformity in this way, and his patient died after amputation. Terbelzi reports a successful case.[3] Mr. Davies-Colley successfully resected a wedge-shaped piece from the tarsal bones, in an extreme case of talipes equino-varus. The patient was twelve years old; both feet were affected, and were operated on successively after an interval of two months. The result is reported to have been excellent, the patient being able to place the whole sole upon the ground, and within a year of the operation to walk six miles.

This operation has met with favor in Germany, and successful cases have been reported by Mensel, Hueter, Schede, König, Rupprecht, and Ried; and in England by Messrs. Bryant, West, and Barwell. In one of König's five cases death followed ten days after the operation; but on a post-mortem examination, ulcerative endocarditis with pathological changes were discovered. In none of the other reported cases did death occur. The operation in the hands of German surgeons was not confined to adults, but used in children as young as four years of age.

Mr. Davy, who reported three cases of excision of the cuboid bone for club-foot, became convinced that more of the tarsus must be removed; and in three other cases removed a wedge-shaped piece from the tarsus. In one of these the patient was a child of sixteen months. The result is said to have been satisfactory in all the cases; but in those where the cuboid alone was removed, greater improvement in position could be hoped for. In one later case of talipes equinus, a wedge-shaped piece was removed, but death from septicæmia followed.

Fig. 713. Fig. 714. Fig. 715.



Mr. Davies-Colley's operation for talipes equino-varus.
Fig. 713. Foot before operation. Fig. 714. Bones removed. Fig. 715. Foot after operation (Bryant).

In this case apparently, as in Dr. Mason's, antiseptic precautions were not employed.

It would appear, therefore, that with the use of antiseptic dressings, the operation is a comparatively safe one; and although it is certainly bad surgery to resort to excision in young children, or in cases where the ordinary treatment by tenotomy and apparatus can be used, the procedure is justifiable and called for in inveterate cases where circumstances prevent the correction of the deformity in the usual way.

The incision necessary for this operation is either a curved one along the outer border of the foot, beginning below the malleolus, and reaching nearly to the small toe, or a shorter incision with a cross cut reaching over the dorsum of the foot. The latter is used by Mr. Davies-Colley, Mr. Davy, Mr. Bryant, and others; the former is recommended by Mr. West, and was used in a successful case by Dr. Porter, of Boston, and by the writer in two satisfactory operations.

Tenotomy appears not to be always necessary either before or after the operation, although it is not contra-indicated. The amount of bone to be removed varies necessarily in different cases. Mr. Davies-

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[1] British Medical Journal, Oct. 19, 1872.]

[2] Lancet, March 16, 1878, p. 389.]

[3] Centralblatt f. Chirurgie, No. 24, 1877.]

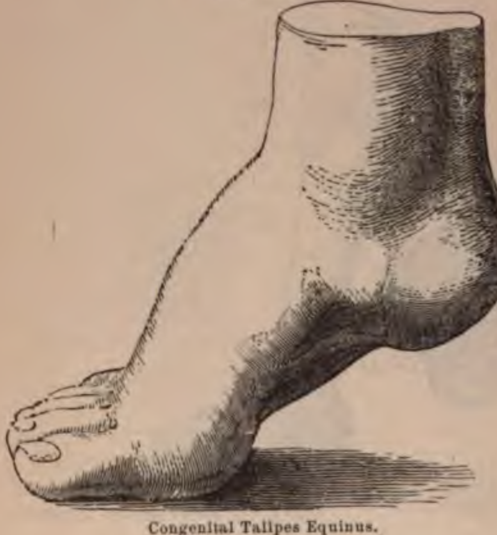
Colley removed the cuboid entirely, a portion of the head of the os calcis, and the astragalus, a large part of the scaphoid, portions of the three cuneiform bones, and the heads of the two outer metatarsals.

Ried mentions having operated by boring through the astragalus and the malleoli, and inserting a key-hole saw with which the bone was sawn in two directions, so as to separate a wedge-shaped fragment.[1]]

Congenital Talipes equinus, Talipes equino-varus, Talipes valgus, Talipes equino-valgus, Talipes calcaneo-valgus, and Calcaneo-varus.

By talipes equinus is understood morbid contraction of the muscles of the calf, and consequent depression of the toes, the adductors being unaffected. This is a very rare *congenital* affection. We have met with two cases in the same family—the first-born, and the last child, the eleventh. When it has not been treated in infancy, locomotion is effected on the inferior extremities of the metatarsal bones and phalanges. In severe cases the internal margin of the foot is slightly inclined inwardly, and the metatarsus is projected forwards. There is not, as in varus, any disposition to tread exclusively on the outside of the fifth metatarsal bone.

Fig. 716.



Congenital Talipes Equinus.

The existence of congenital talipes equinus has been emphatically denied. It is a question of fact and capability of discrimination. It may be suspected that the rare cases of congenital equinus which may have fallen under the observation of those who have denied its existence have been erroneously classed as varus. In congenital contraction of the muscles of the calf, owing to the morbid elevation of the heel, the narrow portion only of the trochlea of the astragalus is retained within the malleoli, and the front of the foot falls or is drawn readily either inwardly or outwardly; the more ready or usual direction being inward; just as we see in some sound children there is a preponderance of the adductors (tibiales) over the peronei, and the feet are consequently observed to be turned in more often than out. Consequently the surgeon who makes no allowance for the ordinary tendency of the feet to incline, and who considers a case to be varus when he sees the foot with never so slight an inward inclination, does not believe in the existence of congenital talipes equinus.

The few cases of unoperated congenital adult equinus which we have seen have remained talipes equinus throughout. The patients have continued to walk on the metatarsal extremity of the great toe, as well as on the little toe.[1] The great toe has never been raised from the ground, as it is in congenital varus. No original or secondary affection of the adductors had drawn the foot in, so as to resemble congenital varus or even non-congenital equino-varus. The patient, we repeat, still walked on the great toe and the little toe.

If congenital equinus be rejected upon the ground that must be taken by those who deny its existence, then it may as justly be asserted that neither does non-congenital talipes equinus exist; for there

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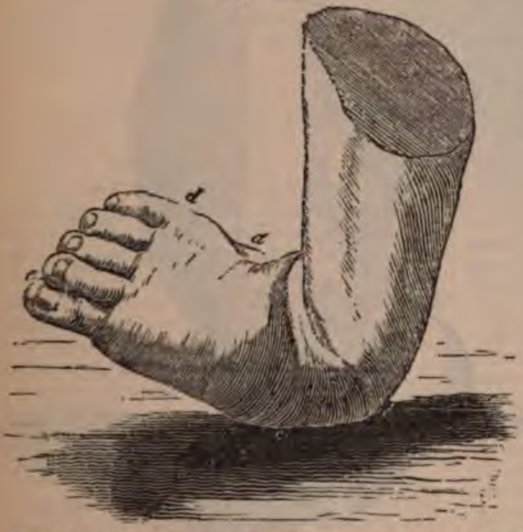
[[1] Davies-Colley, Medico-Chirurgical Transactions, 2d series, vol. xliii., 1877; Davy, Brit. Medical Journ., Dec. 15, 1877, and Lancet, March 16, 1878, 389; Mason, New York Medical Record, July 14, 1877; Ried, Deutsche Zeitsch. f. Chir., 1880, xiii., 114; König, Centralblatt f. Chir., Feb. 13, 1880; Rupprecht, Centralblatt f. Chir., March 13, 1880; Mensel, Centralblatt f. Chir., 1880; West, British Medical Journal, 1878, ii., p. 657; Bryant, Medical Times and Gazette, Dec. 7, 1878; Whitehead, Brit. Med. Journ., Nov. 27, 1880, p. 847; Poinset, Ibid., Oct. 30, 1880.]

[1] We have recently examined an adolescent with well-marked hereditary congenital equinus. It was further remarkable by constituting the fifth example of the deformity in living members of the family, viz., the father, two paternal uncles, and one aunt.

is no non-congenital talipes equinus in which a trace of inversion or of eversion cannot be discovered, which when very marked is termed either talipes equino-varus or talipes equino-valgus.

Fig. 717.



Front view of a congenital Talipes Valgus of the right foot of a boy aged four years: *d a*, the outer edge of the foot raised from the ground; *e*, the great toe raised from the ground, although the internal edge of the foot is directed towards it; *b*, the internal malleolus; and *c*, the internal extremity of the navicular bone, being the parts upon which the patient walked.

The dispute as to the existence or non-existence of congenital talipes equinus continues for the same reason that discussion is endless in every department of natural history, as to whether a given object belongs to one species or forms another species; one observer recognizing a radical difference, which another observer either overlooks or explains away as belonging to another species.

Talipes valgus, equino-valgus, and calcaneo-valgus, are the terms applied to those distortions which contrast most with talipes varus, or ordinary club-foot. The front of the foot is more or less turned out in each of these varieties, instead of being inverted as in varus. In valgus the peronei are the muscles mainly contracted; in equino-valgus the tendo-Achillis is also tense, and the heel elevated, the toes at the same time pointing outwardly. In calcaneo-valgus the heel is depressed through the contraction of the anterior tibial, and the toes pointed outwardly from tension of the peronei.

The foot-deformities named respectively equino-varus and equino-valgus are both non-congenital, and offer other points of analogy, the chief of which is their dependence upon either spasmodic or paralytic contraction as the case may be.

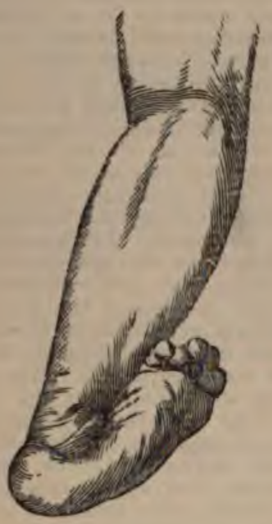
The reader, on comparing fig. 719 with fig. 691, will perceive the similarity of form between equino-varus (a non-congenital affection) and congenital varus, and might reasonably conclude that little reason exists as far as external form is concerned for making any distinction between them. An essential difference is, that congenital varus is fully formed at the time of the child's appearance in the world, whereas equino-varus, when it proceeds from paralysis, is gradually produced, slowly attaining the maximum of distortion. In spasmodic equino-varus also the distortion resulting from either obvious or obscure disorder of the nervous system is rarely complete *ab initio;* on the contrary it is for the most part slowly developed. The analogy of equino-valgus (fig. 720) in some respects with equino-varus is apparent. In both there exists contraction of the tendo-Achillis; both are produced after birth from either spasms or paralysis. In equino-valgus the toe is everted, and not inverted as in varus.

The deformed, enlarged, and protuberant heel of talipes calcaneo-valgus is the consequence of several years' locomotion on the posterior extremity of the os calcis. This bone has in effect, in the fully-developed deformity, a nearly vertical instead of the nearly horizontal position which obtains in the well-shaped foot.

The rules already laid down for judging of the necessity for tenotomy in varus and of the number of contracted tendons to be divided, apply to each of the distortions now under consideration. The principles which should direct the mechanical treatment are equally applicable. The experience of the surgeon and the ingenuity of the instrument-maker are required to adapt the apparatus to the peculiarities of each case.

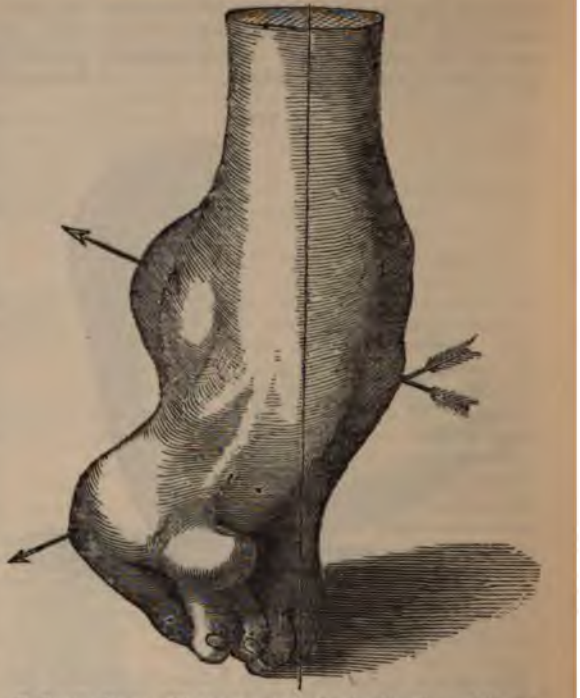
A variety of congenital varus occasionally presents itself, in which the inner margin of the foot is slightly raised, the sole contracted, and the dorsum prominent towards the outer side of the foot, but without elevation of the heel. In these cases the muscles of the ankle are unaffected. We have designated this affection calcaneo-varus. The treatment consists in making pressure by means of a pad upon the prominent dorsum, and in suitable manipulations. A beneficial result is soon observed; but the affection is prone to return. Division of the plantar fascia and of the long flexors of the great toe rarely exercises as much perma-

Fig. 718.



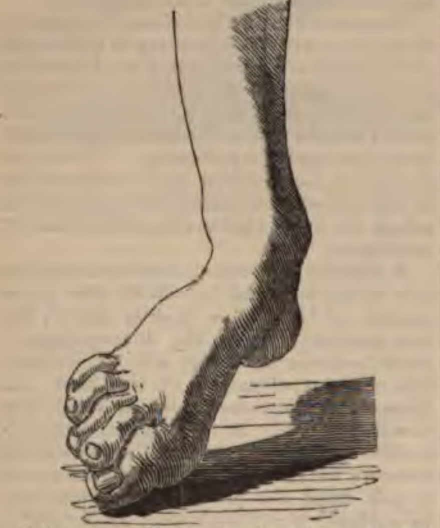
Extreme Congenital Calcaneo-Valgus.

Fig. 719.



T. Equino-Varus. The arrows indicate the direction of the convexity of the tarsus and metatarsus, forward and outward; the perpendicular line through the axis of the limb shows the extent of the inward deviation of the metatarsus, by which the base of the little toe, being brought completely beneath the axis, has to support the entire weight of the body in walking; and is, in consequence of its attrition against the ground, a considerable cause of suffering.

Fig. 720.

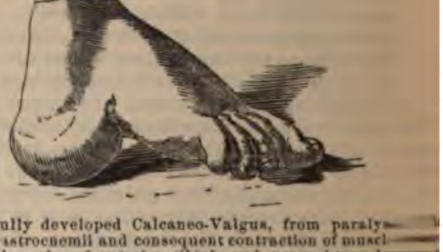


Talipes Equino-Valgus, from loss of power in anterior tibialis, and consequent contraction of calf muscles, and of peronei.

nent benefit as is expected, because the quantity of plantar textures necessarily left unsevered suffice after cessation of the treatment to reproduce contraction.

Some irregular *congenital* foot-distortions are met with. In a few of these we find distinct paralytic loss of muscular power: in one case well-marked paralytic varus, with much atrophy of the soft and hard parts; in another, paralytic contracti[illegible]n of the hips, knees, and feet, with implic[illegible]ation of the upper extremity. The o[illegible]ly treatment applicable is to relieve contr[illegible]ction by manipulation, friction, and in [illegible]nyielding cases by tenotomy, thus offer[illegible]g

Fig. 721.



Fully developed Calcaneo-Valgus, from paraly[illegible] of gastrocnemii and consequent contraction of muscl[illegible] of the sole, of anterior tibial, and peronei muscl[illegible] In some instances the anterior tibial shares the f[illegible] of the gastrocnemii.

a chance to the muscles which remain partially under the will, to support the individual in attempts to effect imperfect locomotion. We have watched these cases from birth to adolescence; in many the paralysis has remained undiminished.

[Yost mentions a child born with marked talipes equino-varus of one foot, where a spontaneous cure took place in three months, without attempt at treatment.[1]]

Distortions originating at the moment of Birth.

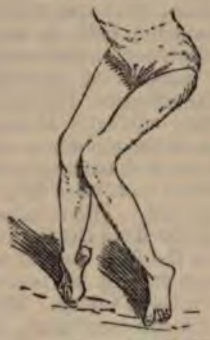
We have seen that in the earliest times of the study of congenital distortions, they were successively attributed to the anger of the Deity, lusus naturæ, malposition in, and pressure of, the uterus. In the present day, an enlarged observation of non-congenital as well as congenital distortions leads irrefragably to the conclusion, that the numerous causes which are found to operate in the production of distortion after uterine existence, exercise analogous if not identical effects, whilst the fœtus remains within the uterus. These causes are, hereditary and maternal influences, disturbance of the nutritive, respiratory, circulatory, and nervous systems of the fœtus and infant, accidents, entanglement by the funis and abnormal bands, intra-uterine fractures, malposition and pressure, fixed repose in one position, and inflammation. In order to illustrate the obnoxiousness to distortion existing at every epoch, we shall here describe a group of distortions, which unquestionably take their origin at the period intervening between uterine and independent life, that is, *during* birth. We believe we can particularize the moment, as that moment which connects placental with pulmonary respiration. When we reflect upon the important phenomena in the economy at that moment when it should adapt itself to the immense changes involved in the abrupt transfer of the oxygenating process of the blood from the placental to the pulmonary cell-surfaces, we should anticipate that any retardation, interruption, or arrest of this transfer of the most important function should be attended with the greatest evil to the system at large, and especially to the nervous system, the most susceptible in the body.

We know that a state of suspended respiration and animation is the common consequence of many of the accidents attendant upon birth; and we might infer, from the evils often witnessed after recovery from the asphyxia of drowning or of choke-damp, what might be the consequences of the apnœa and asphyxia of new-born children. Some of these appear, however, to have escaped notice, until the observations published by the author in 1843. The lungs suffer in the form of atelectasis; the heart probably in delayed or deficient closure of the foramen ovale, and possibly in straining of its walls; the nervous centres from effusions and apoplexy, followed by impeded developments, atrophy of individual parts, sometimes by impaired intellect and volition, convulsions, and spasmodic contractions.

It is scarcely necessary to add, that difficult and instrumental labors, and those in which the cranial bones and brain, and even the vertebræ and their contents, have suffered mechanical injury, are more likely to be followed, if not by death, at least by general convulsions and other serious derangement of the nervous system, of which a prominent symptom are the "internal" or subdued convulsions of the nursery.[1]

A common class of affections resulting from injury at birth, whether the injury be mechanical or vital, consists of a peculiar diminution of volition with tonic rigidity, in varying degrees of a part or of the whole of the muscles of the body, described as, "the spastic rigidity of new-born children." Both lower extremities are more or less generally involved. Often

Fig. 722.



Spastic contraction of flexors and adductors of the lower extremities, consequent on asphyxia neonatorum. Similar distortion may result from "convulsions" during teething, and from other cerebro-spinal affections.

[[1] Medical and Surgical Reporter, Philadelphia, March 27, 1880, p. 283. A case cured through an accident, Lancet, April 20, 1878, p. 566. Club-foot caused by congenital absence of the tibia, Berliner Klin. Wochenschr., May 19, 1879, p. 297; consult also on this subject, Wolff, Arch. f. Klin. Chir., xxi., p. 90; Morton, Philadelphia Med. Times, Oct. 9, 1880, p. 25; Shaffer New York Med. Record, Nov. 23, 1878.]

[1] See Transactions of the Obstetrical Society, 1862.

one limb only is referred to by the parents; but careful examination usually shows a smaller degree of impairment in the limb supposed to be unaffected. This state of peculiar spastic rigidity of young infants may even continue through the whole duration of life. We have known patients over forty years of age thus affected from birth.

The amount of contraction in the hips, knees, and ankles is often considerable, and the leanness proportionate to the contraction. The flexors and adductors of the thighs, the flexors of the knees, and the posterior muscles of the legs preponderate. The thighs and knees cannot therefore be completely extended, or the heels be applied to the ground. In some cases the upper extremities are held down by the preponderating action of the pectorals, teres major and minor, and latissimus dorsi; the elbows are semi-flexed, the wrists partially flexed and pronated, and the fingers incapable of perfect voluntary direction. Participation of the muscles of the trunk is sometimes shown by the shortened, flattened aspect of the pectoral and abdominal surface, as compared with the more elongated, rounded form of the back. The prominence of the back partially disappears on recumbency; but the greater weakness of the muscles on the dorsal aspect of the trunk is obvious when the individual again attempts to sit upright. The inability and indisposition to exert the abdominal and other muscles concerned in the expulsive processes may, perhaps, sufficiently explain the tendency both to rare micturition and defecation, which sometimes exists. The muscles of speech are often involved, the affection varying in degree from inability correctly to utter one or more letters of the alphabet, up to the entire loss of the articulating power. During the earliest months of life, deglutition is often impaired. The intellectual functions may suffer from the slightest impairment, which the fond parent unwillingly acknowledges or fails to perceive, up to entire imbecility or idiocy. The functions of organic life are unaffected, except perhaps that of development of caloric, although the depression of temperature may be more dependent on the want of proper exercise. The appetite is good; the frame generally, in average cases, is well nourished, although with less than the average adipose deposit. The child is often described as the healthiest of the family, escaping epidemics, or having these disorders less severely than the brothers and sisters. These subjects often lead a more precarious existence during the first weeks after birth; at first even vegetative life languishes, often because premature birth or difficult labor, by impairing the maternal supply of nutriment, renders more difficult the infant's recovery from the shock the system has received. However, in the majority of instances, after restoration of the vegetative functions, a gradual amelioration of all the functions of animal life is perceptible.

Although at first convulsions are the rule, the *spastic* contractions are not present, or are not observed, until some weeks after birth. The child's limbs are simply weaker; the convulsions and the question of viability alone occupy the thoughts of the attendants. Before the age of three or four months, though sometimes in slight cases not until the ordinary time for locomotion has arrived, the nurse perceives that she is unable properly to separate the thighs or knees for purposes of cleanliness; that the child never thoroughly straightens the knees; that he does not attempt to stand, or is incapable of standing except on the toes, or that the feet are disposed to cross each other. Even children slightly affected rarely "go alone" before the age of three or four years; many are unable to raise themselves from the ground at that age, and others do not walk even indifferently at puberty. Locomotive ability seems to advance in proportion as the intellectual powers are developed. The external form of the cranium occasionally exhibits departure from the normal type—such as general smallness of the skull, depression of the frontal or occipital region only; sometimes of one lateral half of the skull, sometimes of one-half of the occiput only.[1] In slight cases the head has been well developed. The *ensemble* of phenomena points to injury more or less extensive of the cranial contents, and especially of the medulla oblongata and spinalis.

In all cases, even with great inertia as to the exercise of volition, common sensibility appears little if at all deficient. On the contrary, a morbid sensibility of the organ of hearing and of the cutaneous envelope appears to exist, evinced by "startling" at the slightest noises, and extreme sensibility to touch. This morbid sensibility may be due to a condition of spinal cord analogous to that present in narcotized frogs, in individuals under the influence of strychnine, or those affected by tetanus. It may, however, be apparent only, dependent upon the individual, when subjected to common noises, being less competent quietly and promptly to reason upon them, and by thus reassuring the easily disturbed nervous mind, to escape from the exciting influence. In many cases the intellect has been intact.

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[1] Morbid anatomy reveals in these cases a corresponding deficiency in size of the affected parts of the cranial contents.

A peculiarity of these children—an uncommon fear of falling—is often observed when they are seated on a couch, less when they are on the floor, and not observed when they are seated in an armchair; a circumstance clearly due to conscious inability to balance and recover the position of the body.

Spastic Contractions from Cerebro-spinal Disease in Infancy and Childhood.

We have just described a state of more or less general spastic contraction, which results from disturbance of the cerebrospinal centres at the moment of birth, either from direct injury to the cranium or neck whilst passing through the maternal parts, or, more probably, from asphyxia consequent upon interruption to the substitution of pulmonary for placental respiration. Sometimes, without either premature or difficult labor having preceded, convulsions occur very soon after birth, during the first hours, days, or weeks of independent existence. Convulsions, as is well known, occur more frequently after dentition has made some progress, whilst the infant is undergoing another transition, that of passing through the crisis from nourishment by the mother's breast to feeding, when unfavorable consequences of deprivation of breast-milk are apt to show themselves. The infant may be of previously unexceptionable history, except that the parents may be the subjects of disorders of the nervous system, of nervous temperament, have overtasked brains, have been phthisical, or are intemperate. These convulsions now and then leave the sufferer impaired in mental power, and affected with spastic rigidity, undistinguishable from that which succeeds apnœa and asphyxia neonatorum. (See fig. 722.) It is scarcely necessary to add to the previous remarks on spasmodic and paralytic contractions that convulsions and other cerebro-spinal morbid states of childhood may be followed by spastic contraction, or paralysis of single muscles or of sets of associated muscles.

[Dr. Sayre has called attention to a variety of reflex partial paralysis resulting from genital irritation and relieved by circumcision. The forms of nervous disturbance observed are chiefly incoördination of motion, more rarely muscular spasm.[1]]

Treatment.—The indications for either the operative or mechanical treatment of these different forms of spastic and paralytic contractions, and the mode of conducting the treatment, are the same as those laid down in speaking of congenital club-foot (p. 335), modified by the nature of the cause of contraction. In contradistinction to congenital contractions, we may remark, that in contractions occurring during teething, the occurrence of structural shortening may generally be prevented by timely-applied manipulations, frictions, mechanical support to paralyzed parts, or assistance to the antagonists in the case of spastic affections. It should be remembered as a reason for avoiding unnecessary tenotomy, that the contracted muscle is often the healthier one, and that in the case of a spasmodically affected muscle, tenotomy does not "cure" the spasm. It is often only temporarily beneficial, and sometimes transfers the preponderance to another set of muscles, merely substituting one evil for another. In severe general spastic contraction, the surgeon has carefully to balance the good and evil, one against the other.

Flat-foot, or spurious Valgus.

This common deformity presents externally many of the characters of congenital valgus, and of the acquired valgus which results from paralysis of the anterior tibial muscle. But the resemblance is only superficial. The person treads unduly on the inner margin of the foot, the toes are turned outwardly, and the arch of the foot is diminished, or, in severe cases, may be obliterated; hence the term flat-foot. True valgus springs from congenital contraction of the peronei muscles; spastic non-congenital valgus from spasm of the peronei; paralytic valgus from partial or total paralysis of the anterior tibial; sometimes combined with paralysis of the posterior tibial, causing contraction of the peronei owing to the want of antagonists; but spurious valgus or flat-foot is due to general want of tone in the fibrous structures of the body,—displayed in the yielding of one of the parts of the frame most exposed to strain, the plantar muscles and ligaments; hence sinking of the arch, eversion of the toes, and secondary contraction of the peronei. After a time the displacement of the tarsal bones, connected with the sinking of the arch, leads to painful or difficult locomotion and limitation of the movements of the ankle-joint. Finally, the tarsus may be said to be convex inferiorly, concave superiorly, the anterior part of the foot being then drawn up by the conjoint action of the anterior tibial and the extensors of the toes, and the heel held tensely upwards by the muscles of the calf. Even in moderate cases contraction

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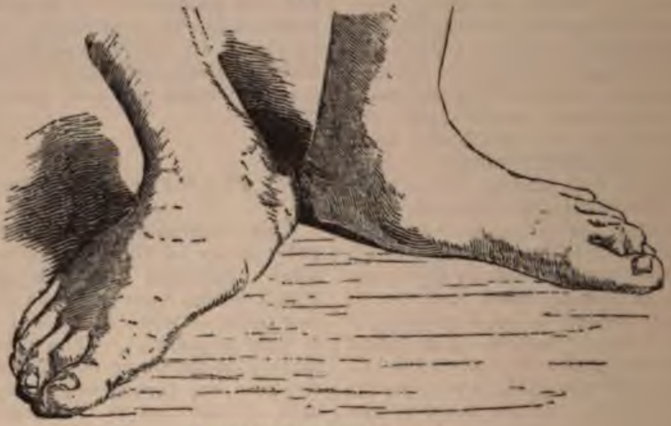
[[1] Sayre, Trans. Am. Med. Assoc., 1875; Hamilton, Am. Journal Med. Sciences, Oct., 1879; Yale, New York Med. Journal, Aug., 1877.]

of the peronei is distinctly felt; in severe cases shortening of the remaining muscles above enumerated is also evident. In the worst cases scarcely any mobility of the ankle-joint remains. A slight degree of flat-foot is common in girls, especially amongst those of fine organization in the upper and middle classes of society; less frequent in boys; and is curable amongst them by considerably reducing the amount of standing and walking exercise, by substituting horse exercise where practicable, by avoiding too fast walking in the company of adults, by early hours, by avoiding competitive over-study, by generous living, fresh air, tonics, attention to the state of the primæ viæ, embrocations, and manipulations directed to the promotion of inversion of the foot and prevention of the threatened contraction. In greater relaxation of the parts about the inner ankle, actual confinement to a couch, and carriage-exercise for a month or five weeks, or that time spent on the sands or beach at the sea-side, will lay the foundation for cure. Laced boots, supported at the sides with stiff leather or thin steel busks, are of great assistance in walking. An elastic horse-hair, India-rubber, or felt pad beneath the inner margin of the foot tends to support the arch. Iron and cork, often employed for this purpose, are harsh and inefficient. We must utterly condemn a practice often resorted to in contempt of the pathology of the affection—that of severing the peronei and tendo Achillis in all such cases. The recovery of patients from moderate flat-foot when this operation has been performed, is due mainly to the absolute repose of the limb with which the operation is followed, and to the mechanical measures concurrently employed. But in a few rare cases in private practice, and in those of boys who have stood prematurely behind a counter twelve or fourteen hours daily, and amongst the lower classes in public institutions who have suffered from premature labor, the deformity has existed so great a length of time that the contracted muscles have become shortened and rigid, rendering tenotomy, with its promptness and certainty of action, a necessary adjunct to the mechanical treatment.

Fig. 723.



Severe flat-foot or spurious valgus.

Flat-foot often exists for several years without attaining even an intermediate grade of severity, when all at once a particularly long walk, a leap, or initiation into a standing occupation, becomes the starting-point of a considerable and rapid aggravation. Sometimes evidence of chronic inflammation of the calcaneo-scaphoid ligament, or other plantar structures, or a painfully stretched condition of the plantar nerve, exists. This last symptom is recognized by the exquisite, unbearable, electric-like, painful, tearing sensation described by the patient when he takes a long stride, or stands on the affected leg alone. We should not be induced to operate on flat-foot even on account of its long duration, or of palpable shortening of the tendons before enumerated, since even rigid contraction of muscles, healthy as to their innervation, will yield in a few weeks to judicious frictions, manipulations, disuse of the part (required in this deformity owing to its special exposure to aggravation by walking), and mechanical treatment. As an argument in favor of severing the Achilles and other tendons in slight cases, we have heard the question put, "What harm does the section do?" Now, although the tendo Achillis is very tolerant of the ever-ready operator's scalpel, it cannot be pretended that an unnecessary operation is a benefit. As, in extremely severe cases, the act of walking, after replacement of the tarsal bones, tends to bear down again the tarsal arch, the aid of mechanical appliances is subsequently needed for several months, or even sometimes for two or three years. Relief is much more readily obtainable in the child than in the adult. The apparatus available in these cases is the same as that used for varus, but with the action of the springs, screws, or lever reversed.

Subcutaneous division of the peroneus longus and brevis is effected in a manner similar to the operation of severing the tendo Achillis. The patient should lie over on the opposite side, an assistant holding the foot inwardly, so as to maintain extra tension of the parts. The tenotome should be introduced in front of the tendons, the section proceeding from before backwards.

[Cases of slight talipes varus following a previous osteitis of the lower end of the tibia are to be mentioned; in one case coming under the observation of the writer, recovery from the osteitis had taken place without involving the ankle-joint, but a troublesome valgus resulted.

Either varus or valgus may occur from absence of the tibia, or from an abnormal shortening resulting from previous disease.]

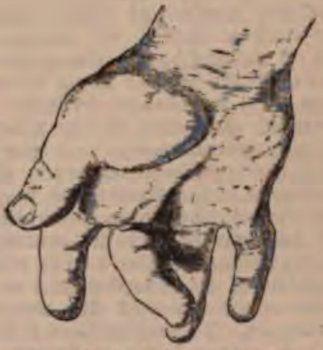
Contractions of the Upper Extremity from Spasm and Paralysis.

The principles which should direct the application of tenotomy to spasmodic and paralytic contractions of the upper extremity are those which are applicable to other parts of the body, except in so far as the functions of the individual muscles of the upper extremity, especially those of the wrist and fingers, are more delicate, varied, and complex than, for example, are those of the corresponding parts of the lower extremity. We should be prepared to expect that a surgical proceeding which aims at intercalating a piece of new tendon, with the object of reducing the range of action, and therefore the power of a rebellious spastic muscle, or for the purpose of thereby weakening a healthy muscle so as to favour a partially paralyzed antagonist to recover its activity, would be less successful than in the lower extremity, the actions and movements in which are comparatively simple. The acquirement of the power of progression, even if it be incomplete, amply compensates for the sacrifices the patient makes; in bad cases he is satisfied with the possession of a limited flexion and extension of the hip, knee, and ankle, and can be aided by mechanical appliances. But in the case of the wrist and fingers the individual derives little benefit from these simple movements, and he cannot be materially assisted by any complicated mechanism hitherto invented. We have divided the biceps at the bend of the elbow, the rigid well-defined pronator radii teres at its muscular portion, the tendons of the flexor carpi radialis and ulnaris where most prominent close to the wrist, and have found the resulting benefit proportioned to the attention subsequently bestowed upon manipulations, passive exercises, and painstaking education of the enfeebled non-contracted extensors. Except in cases of many years' duration, in which the retracted muscles were reduced to inextensible fibrous bands, it has seemed that as much ultimate benefit was obtained by manipulations and exercises as by the employment of an operation, and at no greater expenditure of time. The prognosis must be based on the amount of improvement that may be expected in the affected portion of the nervous centres. As an encouragement to treatment, the surgeon should remember that cases occur in which the disorder of the nervous system and nerves has ceased, and that he has to deal only with consequences. This observation applies also to many congenital contractions.

Deformity from Disease of the Palmar Fascia.

A not uncommon contraction in the upper extremity consists in a permanently flexed condition of one or more fingers, with visible and palpable thickening and hypertrophy of the fascia investing the palmar surface of the first phalanx of the affected finger, and of the neighboring portion of the palmar fascia. Sometimes the whole of the fingers and thumb are implicated, the palm itself is contracted,

Fig. 724.



Contracture of palm and fingers from disease of palmar fascia.

and the use of the member as a prehensile, and even as a tactile, organ almost destroyed. The ring and the little fingers, the middle finger, index, and thumb, are usually affected in frequency and degree in the order in which we have placed them. The articulations are commonly unaffected, although occasionally that of the first phalanx with the second phalanx, or this with the third, has exhibited slight arthritic enlargement. On endeavoring to straighten the fingers, the surgeon feels that a general resistance is offered by the tissues of the entire palmar surface of the hand and fingers, and especially by the indurated palmar fascia itself. Any existing tension of the flexor tendons cannot be felt along the fingers, but in the palm, particularly in the upper part, above the edge of the most indurated part of the palmar fascia, one or more prominent and tense tendons may be felt. This deformity is usually attributed to injury, often to a trifling wound, to irritation by the use of a whip in driving, of a walking-stick, or mechanical tool. These mechanical causes, or local irritants, if really operative, can be regarded only as occasional determining or exciting causes. The essential or primary cause is a constitutional one, allied to the gouty or rheumatic diathesis. We may not venture, however, to assert that the constitutional cause is identical with that of gout or rheumatism, as the persons affected have appeared singularly free from other manifestations of those affections. The disease of the palmar fascia, unlike gout or rheumatism, is painless. Many patients affected with considerably contracted palmar fascia in both hands present similar induration of the corresponding fascia of the soles; a sufficient proof that the complaint is essentially independent of the mechanical causes assigned for it,—unless, indeed, we assume that the act of walking by stretching the sole can act upon the plantar fascia after the manner of a mechanical irritant. The symmetrical character of the affection, the precise resemblance of one case with another, the occasional existence of hereditary gout in the family, the frequent occurrence of the same deformity in father and son for several generations (four), as well as the above facts, confirm the opinion of its constitutional origin. We have never witnessed this complaint in the female. Those who have freely indulged in strong wines and spirits, or beer, are frequent subjects of it.

We regard it, then, as a painless chronic induration of the fascia, leading to compulsory, gradually-increasing disuse of the fingers and hand. Through this disuse the flexor muscles and tendons, which are probably free from the original affection, assert their preponderance over the equally idle extensors, and become generally affected with secondary shortening.

Treatment.—Even in tolerably advanced cases, frictions, manipulations twice or oftener daily, the application of a screw-adjustment splint, or straight splints of wood, tin, or gutta-percha, will, if suitably and perseveringly used, reduce the contraction and deformity. But at the advanced age at which many patients present themselves for relief, the employment of mechanical apparatus encounters many difficulties. In rigid unyielding cases of long duration, tenotomy is remarkably efficacious. We cannot by its means alter the constitutional state, or directly remove the induration of the fascia; but we are enabled to remove by tenotomy the secondary tendinous contraction, to take the case entirely out of the influence of the patient's will, so far as the contracted muscles are concerned, and obtain a starting-point for further benefit by mechanical treatment. A puncture half a line in width suffices for the passage of a firm tenotome beneath the tendon in the palm. The tendon is thus divided from below upwards. No fumbling or unnecessary handling of the part after the operation, by which means air or blood might be disseminated amongst the palmar tissues, is permissible. The operation, like most subcutaneous operations, is bloodless. We have invariably seen the puncture heal within forty-eight hours. Considerable yielding of the contracted finger, the tendon of which has been severed, is at once perceived. Manipulations and mechanical treatment complete the cure. We have frequently thus effected entire restoration of the hand and fingers. It is remarkable that the indurated fascia softens, and the hard ridges and corresponding furrows in the fascia disappear, under this treatment. It is obvious that the afflux of blood to the part, excited and maintained by the frequent manipulations, frictions, and bandages, alters the nutrition of the part, and removes the previous morbid deposit. It is also probable that caution as to diet and wine whilst under the observation of the surgeon, assists this process of recovery. The causes being constitutional, and the attention of the patient being liable to slacken after a lengthened recovered use of the member, the complaint occasionally returns. We have re-operated on a patient thrice in eleven years; the individual expressing himself amply compensated for the operation by nearly as many years' good use of the part. This operation is a valuable illustration of the success of subcutaneous tenotomy compared with Dupuytren's painful operation, even when performed by so able a surgeon as the late Sir A. Cooper. We have had under observation two cases in which, by means of a large crucial incision of the palm, the indurated fascia had been dissected out and removed. The operation had no better result than that of causing a large contracted cicatrix, more rigid than the former state of things, and quite irremediable.

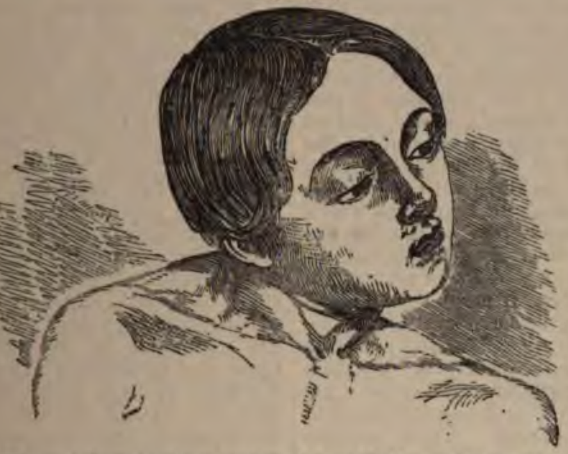
[Mr. Wm. Adams advises as a mode of treatment for Dupuytren's contraction, subcutaneous division of the palmar fascia and immediate extension. It is necessary to divide all the contracted bands of the palmar fascia, and for this purpose Mr. Adams uses a very small tenotomy knife, inserting it under the skin and cutting from above downward. The finger should be immediately extended and bandaged to the splint, which should not be removed until the fourth day. A splint should be worn night and day for three weeks, and at night for three or four weeks longer. A relapse is said not to occur.[1]

Busch, of Bonn, divides the tense fascia after having raised a skin flap on the palmar surface of the hand; the flap is then replaced and sutured. For some days the finger is left free, but when the wound granulates a cylinder of wood is placed in the palm for a few days, and after this the finger is extended by a dorsal splint.]

Wry-Neck.

Torticollis, or wry-neck, is a not very uncommon distortion of the head and neck, originating, like club-foot, from a variety of influences; some acting through the muscles—congenital, spasmodic, paralytic; others acting through the ligaments and bones—rheumatic and strumous. Occasionally the point of departure of a case is strumous affection of the lymphatic glands, and sometimes loss of textures from sloughing after burns or a gunshot wound.

Fig. 725.



Wry-neck from spastic contraction of sterno-cleido-mastoid muscle.

Congenital wry-neck.—This is the most common form of wry-neck. It is perceived a few months or more after birth, and, when suffered to proceed unchecked, gradually increases during childhood, adolescence, and adult life, until it attains the proportions of a formidable deformity. Many cases of wry-neck, reputed to be congenital, have appeared to originate from accidents at birth, in consequence of breech presentation, turning, etc. We will describe an adult case, in which the right sterno-cleido-mastoid is the head and front of the offending, for it is probable that other muscles are always either primarily or secondarily involved. The entire head leans to the right side and slightly forwards, the right side of the neck is somewhat hollowed, whilst the left side is unnaturally convex, and the patient not unfrequently complains of pain in this situation. These changes in the form of the neck are more pronounced at the upper part, *i. e.*, opposite to the base of the cranium, that being the region most influenced by the contracted muscles. The chin is drawn to one side and approaches the left shoulder; the right ear is approximated to the sternal extremity of the clavicle. The sterno-cleido-mastoid muscle of the affected side (right) has lost its symmetry, being reduced to a comparatively narrow, hard,

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[[1] Lancet, June 9, 1877, p. 838; also Dupuytren's Finger Contraction, by Otto W. Madelung, published by G. P. Putnam's Sons; also Berl. Klin. Woch., No. 15, 1875.]

tight cord, three inches in length, the muscle of the opposite side measuring five and a half inches. This prominent cord is double below, representing the double origin of the muscle. In the adult a marked upward bend of the clavicle is often seen where the clavicular portion of the contracted muscle arises, induced by the constant abnormal traction to which the bone has been subjected, and the inferior portion of the muscle itself appears of cartilaginous or osseous hardness, and is lost in a large bony process on the protuberant clavicle. If we examine the neck and shoulders posteriorly, we observe that the cervical vertebræ have yielded to the dragging of the contracted muscle; this part of the vertebral column presenting a convexity on the left side, which is compensated for by a curvature in the opposite direction lower down. The right side of the head, neck, and right shoulder are considerably smaller than the parts on the opposite side; the right shoulder and scapula being unduly raised. A singular effect upon the face results from this difference in size, combined with the impediment to the function, which the abnormal position of the head involves. In the adult case from which we describe, so great is the difference in size between the two sides of the face, that on the right side the external canthus of the eye is distant from the external angle of the mouth three inches, whilst on the left the distance amounts to three and a half inches. The inclination of the head to the right causes the right eye to be habitually situated on a still lower plane than would be the case if atrophy of the affected side were alone operative. The atrophy and the slight bending forwards of the head interfere with the direction and use of the right eye, and cause a peculiar expression of archness and sense of difficulty and suffering. These features of the deformity are, as already mentioned, proportionally less marked in early life.

The principal muscles of the neck are probably involved, the trapezius and scaleni, as well as the sterno-mastoid. In this and other respects congenital wry-neck offers much analogy to congenital club-foot. The principal contraction affects in both cases muscles which pass over more than one articulation, the sterno-cleido-mastoid in one case, the gastrocnemius in the other; hence in the neck the mischief of morbid contraction may effect a higher degree of deformity than if the contracted muscle influenced one articulation only; in the leg the contracted gastrocnemius does not always limit its evil influence to the foot, but may contract and distort the knee. In both wry-neck and club-foot other muscles participate in the deformity; but the range of influence of those being less, or being counteracted by antagonistic powers, their contraction is not so apparent. It is an interesting question of physiological pathology, whether there is anything special in the anatomy and function of the sterno-mastoid and gastrocnemius, that they should obtain the distinction of entering into so large a proportion of cases of congenital and acquired deformity. The gastrocnemius, by its great development, its greater nervous supply, and its relation to the upright stature and locomotion of man, is certainly entitled to a peculiar and elevated rank in comparative and human myology; so, when we reflect upon the size of the sterno-cleido-mastoid, its relation to the large vessels of the head and neck, its deriving its nerve-power mainly from a special nerve (spinal accessory), and remember the influence of this muscle upon the act of respiration, we cannot deny it a pre-eminent function amongst its neighboring muscles.

We have elsewhere shown[1] that not unfrequently wry-neck appears to result from straining or injury to the neck during difficult labor, from traction of the head by instruments. It is superfluous, after what we have said of the causes of congenital club-foot, p. 333, to refute in detail the theory which would attribute wry-neck, like club-foot, to accidental uterine or pelvic pressure. Congenital wry-neck clearly originates from causes acting through the nervous system.

Treatment.—It is probable that, as with slight congenital club-foot, so slight cases of congenital wry-neck, if early detected, are removable by frictions, manipulations, and subsequent education; but all the cases we have seen, varying in age from four to forty-five years, have exhibited so much contraction and proportional secondary deformity, that we have in no case delayed division of the sterno-cleido-mastoid. It has always seemed justifiable to gain at once, by means of this operation, a large measure of relief; thus affording an encouraging starting-point for the after-labors of the attendant in overcoming the shortening of the integuments, platysma, fasciæ, associated muscles, and ligaments on the hollow side of the neck, and, in this way, gradually acting upon the altered relation of the articular facets of the inclined vertebræ.

Division of the sterno-cleido-mastoid is performed subcutaneously, upon the principles practised by Stromeyer in division of the tendo Achillis, viz., effecting the division by the smallest possible wound in the integuments and the narrowest tract through the subcutaneous tissues, and avoiding any external bleeding or extravasation of blood into the areolar tissue, or admission of air into it. Neglect of these precautions would be calculated to excite suppuration and prevent immediate healing of the puncture, and delay untowardly the employment of the necessary after-treatment, until, perhaps, the severed tendon might be reunited and implicated in the surrounding adhesions, the case thus becoming less amenable to the necessary mechanical treatment than before operation. The spot chosen for the operation should be that at which the tendon springs rigidly across the important subjacent organs, and where consequently most space is afforded for introduction of the tenotome beneath the tendon without risk to those organs. In wry-neck this spot will be found from a half to one inch above the clavicle. It is also more easy to sever the muscle entirely by keeping at this distance from the bone. In some cases we have found the sternal portion only developed and rigidly contracted; a few weak fibres attached to the clavicle having, before the knife reached them, yielded to the tension maintained by the assistant. In cases in which the clavicular origin of the muscle is broad, it is safer to divide the sternal and clavicular portions each by a separate puncture, rather than to pass the knife by one puncture made in front of the neck as far back as may be necessary to reach the whole of the clavicular portion. This precaution is justified by the anterior and posterior edges of the muscle not being on a plane surface; for although the fasciæ of the lower part of the neck may usually bind down sufficiently the vessels and nerves, and so keep them out of danger, it is well to remember the liability of meeting with abnormal distribution. The complete division is accompanied by a very sensible crack, and the head at once assumes a much improved condition. We have measured immediately after operation, and have found the difference in length between the affected and sound muscle reduced more than one-half. The puncture should at once be covered with a compress of lint, and a common bandage be applied. We have found no harm result in the case of the sterno-cleido-mastoid in allowing the ends to separate as far as they were inclined to yield. In young and flexible subjects, we have found adhesive plaster and a common roller-bandage an amply sufficient mechanical contrivance to aid in rectification of the head. Apply a long strip of adhesive plaster around the forehead and occiput, its maintenance in position being better secured by a bandage passed over the vertex and beneath the chin, the two being pinned together where the one passes over the other, above the ears. Next attach around the waist a broader band of adhesive plaster, not so tight as to interfere with the movements of the ribs; over this a turn or two of calico roller-bandage; the two should be fastened together by a stitch here and there. The surgeon has now two circular bandages, the one around the forehead, the other around the waist, which are not likely to slip if properly applied. He should then sew a strip of ribbon to the head bandage directly above the ear of the unaffected side, and carry it diagonally across the trunk to the opposite side of the waist bandage, and there pin it. By this means the left mastoid process (we are speaking of wry-neck caused by contraction of the right sterno-mastoid) will be drawn towards the right sterno-clavicular articulation, the original wry-neck be removed, and the chin brought to the median line, or in young and flexible subjects even across it, towards the affected side, constituting a temporary wry-neck in the opposite direction. The circular or ovoid form of the cranium renders it difficult to act upon it for any length of time by any apparatus hitherto invented. The apparatus will shift its direction, or rather the head will partially disengage itself. Hence even a greater necessity for manipulations exists in wry-neck than in other deformities. No apparatus effects so beneficial and lasting an impression upon the distortion as the hands of the surgeon or attendant. Whilst one holds down the shoulders, the other, standing or sitting behind the patient, should apply firmly his flat hands to the sides of the head, and direct the chin, vertex, or occiput in the required directions. The patient should be placed on a lower seat. Such manipulations need to be done with due caution and technical skill. It is not necessary to cause pain in order to produce much good. They should be employed three times a day. The plaster and roller-bandage which we have described is most convenient in reference to these manipulations. It may be unpinned in a moment, and as quickly readjusted. We have cured many cases by the means here enumerated, in periods varying from one to three months, and have never had occasion to repeat the operation. Manipulations as a precaution against relapse may be longer resorted to; but the patient's voluntary efforts are more employed, for obvious reasons, and are more successful, than in some other congenital deformities. An apparatus similar to that described at p. 360, for rectification of the position of the head in deformity from vertebral disease, may be employed in cases of adult congenital wry-neck during some portion of every twenty-four hours. It readily effects re-position of the lateral or forward inclination of the head, but is powerless to affect the abnormal rotation of the head round the horizontal axis.

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[1] Trans. Obstet. Soc., 1862.

Acquired or non-congenital spasmodic wry-neck.—We have seen several cases of active, violent spasm of the sterno-mastoid in both sexes, oftenest in unmarried females of middle and advanced age, causing severe wry-neck. The spasm is commonly jerking, irregular, convulsive, never ceasing entirely whilst the patient is awake. The disorder has usually commenced about the age of thirty, in subjects not obviously hysterical, persons of excellent intellectual and social character, whose families have seemed prone to other cerebro-spinal affections. We have watched several of these cases for many years. The spasm and deformity have in many cases gradually increased, often rendering the patient's existence distressing, through incessant motion of the head, disturbance of sleep, and pain in the neck, apparently due to strain of ligaments and nerve disturbance, and sometimes accompanied with pain referred to the upper part of the spinal cord itself, as in some cases of "spinal irritation." Now and then the spasm is so considerable that the ear of the affected side is drawn down by a series of jerks so as almost to touch the clavicle. The patient's voluntary efforts to arrest the pulling down of the head appear to increase the disorder. Sometimes the coexistent affection of the trapezius draws the head at the same time backwards, and prevents the chin approaching the sternum. In inveterate cases, such as have existed many years, we have employed mineral and vegetable tonics, galvanism, and electricity, with only temporary benefit. However, as might be expected, generous diet, hygiene, and freedom from mental disturbance, alleviate the symptoms. Complete relief is afforded by subcutaneous tenotomy of the affected sterno-mastoid; but even this measure is only useful for a time; for after two or three months, or as soon as reunion of the severed part is complete, the spasmodic shortening and jerking return. Stromeyer had a patient who submitted to two repetitions of tenotomy for the sake of the temporary relief afforded by the operation. The author once operated on an elderly female who had suffered from spasmodic wry-neck upwards of twenty-five years. She had been unable for many years to sleep in the recumbent position, but dozed in a high-backed nurse's-chair, provided with side-supports for the head. For a few nights after the operation she slept soundly in bed. The malady, however, returned, and she ultimately sank exhausted, want of sleep appearing to be a principal cause of the fatal result. The operation on the sterno-mastoid is insufficient to affect the remaining muscles, which are sometimes involved.

In two recent cases of this affection, such for example as have existed less than two years, we cured the patients in a few months, using bromide of potassium. In others the use of the perchloride of mercury has had the most satisfactory effect. In every case which the author has cured, using internal remedies, the value of attention to the primæ viæ has been apparent. For this purpose, half a grain of the ext. aloes barbad. every night has been used. It is not improbable that the utility of hydr. perchlorid. and of argent. nitr., in these and analogous cases, is due to their stimulant action upon the hepatic and alimentary mucous surfaces, rather than upon any direct specific action upon the nerve-tissue serving the implicated muscles. Relapse is not uncommon after every mode of treatment.

An interesting instance of almost perfect cure of an inveterate case in which mere section of the sterno-cleido-mastoid had proved only temporarily beneficial, is fully recorded by Mr. Campbell de Morgan in the British and Foreign Medico-Chirurgical Review, July, 1866. The successful operation consisted in division of the external branch of the spinal accessory and the removal of a piece of the nerve, about a quarter of an inch in length. The patient was seen some two years afterwards with only faint traces of the disorder.

[Mr. De Morgan has since performed a second operation, but without relieving the patient.[1] Mr. Rivington,[2] however, was successful in curing a spasmodic torticollis by resection of the accessorius, as was also Mr. Annandale,[3] after having failed to cure the patient by stretching the nerve. The cure had remained permanent a year later.

Tage Hansen[4] reports two successful cases cured by nerve stretching. In one the head was turned to the left 100 times a minute, and this had continued four years. An incision was made along the posterior edge of the sterno-mastoid, and the nerve stretched in both directions. The contraction reappeared, as the patient was coming out of the anæsthetic, but disappeared shortly afterwards and did not return.]

Paralytic wry-neck is rare; we have not seen more than three cases. The head

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[[1] Lancet, Aug. 3, 1867.]

[[2] Brit. Med. Journal, Feb. 8, 1879, p. 212.]

[[3] Lancet, i., 1879, p. 555.]

[[4] Hospitals Tidende, 2 R. v., No. 45, 1878, p. 705.]

is drawn to one side by the healthy muscle, which is deprived of its antagonist. Sometimes a case occurs in which, in consequence of difficult birth, the head falls helplessly to one side more than is common to new-born infants, probably from mechanical injury to some of the structures in the neck. Such cases resemble wry-neck from paralysis, but differ by the history, and by the evil being less confined to the sterno-mastoid. These weak necks from injury at birth, as far as we have had the opportunity of watching, have gradually recovered. In paralytic wry-neck, when the stage for ordinary treatment of the partial paralysis has passed, we can do no more than support the head by the padded-leather or steel-spring cravat. Except when the unparalyzed sterno-mastoid is structurally degenerated or very rigidly contracted, and is insusceptible of elongation by manipulations or mechanical treatment, it would be as irrational to employ tenotomy as it is in a case of contracted gastrocnemius, which has simply lost its antagonist, and which can be relieved by a suitable mechanical support without operation.

[In a number of non-congenital forms of torticollis, the head is twisted by other muscles than the sterno-mastoid. In some a nervous causation seems probable. The sterno-cleido-mastoid and trapezius muscles are supplied by the spinal accessory, and spasm of these muscles is not uncommonly a cause of wry-neck.

Sometimes the sterno-mastoid muscle is not affected, and a variety which has been termed posterior torticollis occurs, where the muscles attached to the back of the head alone are affected. The spasm may be acute or chronic, lasting for years; tonic or clonic. Various causes are assigned, such as local muscular fatigue, overwork, etc.; in other cases, however, the affection cannot be explained in this way, or on the assumption of a hysterical temperament.

Sometimes the affection is of a mild form, and disappears without treatment, or with medicinal treatment, but frequently it is extremely obstinate, and a variety of means are employed unsuccessfully. Of those recommended the following may be mentioned: Belladonna ointment, injection of sulphate of atropia, counter-irritation, ether-spray, the actual cautery, faradization, or the application of galvanism, or a mixture of both, and massage.

M. Delore has reported great success in treating a number of chronic cases of posterior torticollis, by forcible straightening under an anæsthetic, and fixation by a permanent bandage (silicate of potash strengthened by pasteboard) applied around the head and trunk, and worn for weeks or months.

M. Delore has found that wry-neck, due to a permanent contraction of the posterior muscles, is not so infrequent as has been supposed, and that it may result from a variety of causes.

The attitude may resemble that caused by a contraction of the sterno-mastoid, but in the cases of a pure type this muscle is relaxed, and hence tenotomy or myotomy is not indicated. His method of operating consists in anæsthetizing the patient and grasping the head firmly with both hands; assistants hold the shoulders. The deformity is gradually corrected, and at times the sense of tearing fibrous tissues is felt. After the head is in position, a silicate of potash bandage is applied about the head, neck, shoulders, and trunk, leaving the face and arms free. The bandage is worn a month, and sometimes in severe cases it has to be renewed. In thirteen cases, some of them of deformity of a severe and persistent type, complete success was obtained without relapse.

This method has certain advantages, which are manifest in watching a case so treated. The muscles in a state of spasm are kept more perfectly fixed than is possible by any other apparatus which can be devised, and hence the muscles are not irritated by more or less intermittent strain.

Instead of silicate of potash, plaster-of-Paris bandages have been used by Dr. A. T. Cabot, of Boston, as they harden much more quickly than liquid-glass bandages. The appliance is, however, much more clumsy. Instead of stiffening the bandage by pasteboard, the writer has been able to give sufficient firmness to the bandage, while hardening, by incorporating light strips of iron.

In certain milder cases of posterior torticollis it is evident that it is desirable not only to use force to rectify the position of the head, but, as a help toward this, to support the chin by apparatus, as the weight of the head and its tendency to fall forward is a source of irritation to the muscles implicated in the causing the deformity.[1]]

Wry-neck from disease of the cervical vertebræ is caused by strumous, and some-

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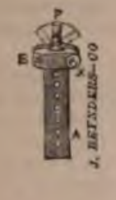
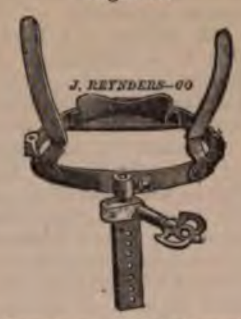
[[1] Delore, Gazette Hebd., March 22, 1878; Mills, Spasmodic Torticollis, American Journal of Med. Sciences, Oct., 1877; Kormann, Schmidt's Jahrbüch., Bd. 179, 1878, p. 298; Swan, Dublin Journal Med. Sciences, Aug., 1879, p. 114; Bouland, France Médicale, 1879, p. 666; Hamilton, New York Medical Journ., Feb., 1880; Bradford, Ibid., Jan. 1, 1880, p. 24; Lancet, April 17, 1880, p. 604; Fisher, Lancet, Oct. 27, 1877, p. 609.]

[Fig. 726.



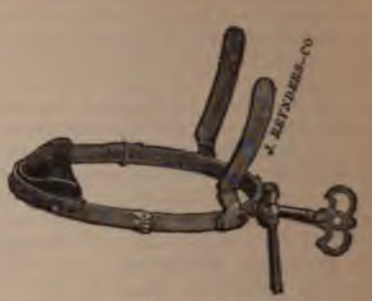
The ball-and-socket joint.

Fig. 727.



Chin-piece, or occipital uprights and chin-cup.

Fig. 728.

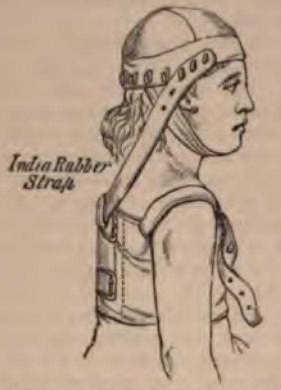


Side view of fig. 727.

Shaffer's ball-and-socket apparatus for treatment of malformations of head.]

times by rheumatico-strumous disease of one or more cervical vertebræ, from which the head inclines to the affected side. The chin is directed to one side, although this feature is less marked than the sideward falling of the head. In bulging of the opposite side of the neck, and in general appearance, these cases much resemble congenital wry-neck, but are distinguished from it by their history, the pain on motion, the aspect of strumous or constitutional disorder, by hectic, by the instinctive aversion of the patient to the surgeon's handling of the head, and concomitant glandular or other forms of strumous disorder in the one case, or rheumatic affection in the other. The pathological changes common to disease of the vertebræ in each region, and its peculiar dangers when situated in the neck, are described in a previous essay. Great caution is necessary in handling these cases, lest the disintegrating bones give way suddenly to the pressure, or the reparative process which may be going on be interrupted. Much benefit to the disease itself, and gradual improvement in the position of the head and neck, may be effected by a well-adjusted supporting and rectifying apparatus, as well as by the recognized medicinal, dietetic, and hygienic treatment of the constitutional malady. We have twice witnessed death as sudden as in apoplexy, in cases in which suitable support of the head had been neglected, and the patients had persisted in maintaining the erect position, having walked about supporting their heads with the hands. The most efficient apparatus consists of a padded metal plate, secured by straps beneath the axilla and around the chest upon the shoulder of the side to which the head inclines. From this shoulder-pad an iron upright piece extends upwards, by the side of the neck, to the parietal region. The lower end of this upright is attached to, and moves upon, the shoulder-plate by means of an endless ratchet-screw; the upper end is connected with a pad intended to be adjusted and pressed against the parietal region. In adults and very severe cases, this apparatus may be attached to a common spinal support for the chest and pelvis, for the sake of greater fixity and more powerful leverage. Sometimes an iron stem is required to extend upwards on one or both sides of the head, with connecting straps to be applied beneath the chin and occiput, so as to receive the weight of the head. Much opportunity for the ingenuity of the instrument-makers is afforded by these cases. In the present day we do not commonly find it necessary to employ the cumbrous and unsightly machines, consisting of an iron scaffold and gibbet for suspension of the head, to which surgeons resorted as lately as the commencement of the present century.[1]

[Fig. 729.



Cap and band for extension in wry-neck (Bryant).]

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[1] [Consult also, Kormann, Schmidt's Jahrbüch., Bd. 179, 1878; Swan, Dublin Journ. Med. Sc., Aug., 1879, p. 117; Torticollis ar-

Knock-knee, In-knee (*Genu Valgum*).

[No subject in orthopædic surgery has, within the last few years, attracted such attention as the treatment of genu valgum; and the recent literature on the subject is copious.

The anatomical researches of Mikulicz[1] show that deformity is not due to an abnormal condition of the ligaments, but to an unnatural shape of the bone, which causes a downward projection of the internal condyle. This is the result partly of a curve in the diaphysis, but partly to an unequal growth of the two sides of the diaphysis near the epiphyseal line. The epiphysis itself in pure genu valgum not the result of arthritis is not altered in shape. Contraction of the outer hamstring is not at present regarded as necessarily present; it has been found absent in many cases, and is not, therefore, in a causative relation with the deformity.

Ollier's experiments have shown that an irritation of the internal condyle could cause a hypertrophy of this part; but though this undoubtedly may cause deformities resembling the ordinary knock-knee, this latter must be considered as not the result of inflammatory changes in the bone, but probably the effect on the growth of bone of abnormally distributed weight. Tripier, Verneuil, and Guéniot agree with Mikulicz, that the deformity is due to an abnormal shape of the femur at the knee-joint, but believe that the change is in the internal condyle itself, which is abnormally lengthened.[2]

Mr. Brodhurst does not regard the lengthening of the condyle as the cause of the deformity; but in this he is at variance with all surgeons who have recently studied the question.[3]]

This frequent deformity, of which instances are met with at all ages, consists of an inward yielding of the knee-joint, in consequence of weakness of the ligaments and muscles which respectively connect or surround the articular extremities of the femur and tibia. Its causes are identical with those which produce in-ankle or flat-foot (talipes valgus spurius), p. 351.

Abnormal states of general nutrition in children and adolescents, dependent upon insufficiency or improper quality of food, are a common predisposing cause of this deformity. Sometimes it appears probable that the constitutional weakness, or laxity of tissue, has been engendered less by unsuitable supply or quality of food than by imperfect assimilation, owing to deficient aëration of the blood, as in children reared in confined dwellings, both in town and country. In many cases, the abnormal nutrition proceeds to the length of developing an unmistakable rachitic condition, known by the coexistence of the peculiar curvatures of bones which characterize that disease. Our observation of the numerous gradations of knock-knee met with in young children, varying in outward appearance from the most flourishing health to the most miserable, wasted, and dwarfed extreme rickets, has convinced us that even in the slighter forms of knock-knee a degree of impaired assimilation of food and an abnormal state of blood, similar to that present in rachitis, exists. In these slighter cases of knock-knee, traces of rachitis will be found in prominence and deformity of the cartilages of the ribs, flattening of the sides of the chest, and sinking-in of the sternum. One or more severe attacks of bronchitis, or broncho-pneumonia, have frequently been with justice regarded by the friends as the forerunner of the "weakness of the limbs." In many instances the earliest link in the chain of causation has been an error in the infant's diet; namely, the substitution, for an insufficient supply of breast-milk, of farinacea boiled in *water*, with the addition of little, if any, cow's milk. Sometimes we may ascend a degree higher, and discover an hereditary pathogenetical influence. We have several times observed knock-knee in small, delicate, prematurely-born children; the limbs, as a consequence of general weakness, having yielded to the superincumbent weight of the trunk. Such cases should not be confounded with the *inverted* flexed and contracted knees which occur in children who, in consequence of premature birth, have suffered from asphyxia neonatorum (p. 349). Knock-knee often shows itself before the child has attempted to walk, this act being occasionally delayed by it as much as three or four years. When the deformity attains a certain grade, it may increase rapidly from the effects of walking, or it may increase so gradually as not to excite the parent's anxiety, until at length, about the age of seven, ten, or twelve years, the child is again "thrown off the feet," and

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ticulaire, France Méd., Oct. 19, 1879, p. 666; Torticollis treated by electricity, New York Med. Journal, Feb., 1880, p. 140; Torticollis from Worms, Lancet, p. 604, April 17, 1880.]

[[1] Archiv f. Klin. Chir., 23, 1879, p. 567.]

[[2] Hueter, Archiv f. Chir., ix., 961; Busch, Berl. Klin. Woch., Sept. 22, 1879, p. 569; Farabeuf, Peyrot, Gaz. des Hôp. Jan. 6, 1880; Tripier, Gaz. Hebd., 1875, No. 38; Verneuil, Revue des Sc. Médicales, ii., 1878, 629; Poore, New York Med. Record, May 22, 1880, p. 562.]

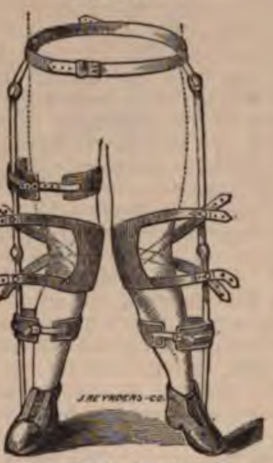
[[3] Chiari, Wiener Med. Woch., Sept. 7, 1878; Farabeuf, Peyrot, Gaz. des Hôp., Jan. 6, 1880.]

becomes incapable of walking without crutches or other support. The deformity often takes place in tall, rapidly-growing lads from the age of twelve to eighteen, who may have exhibited no previous tendency to it. Undue exercise, and fatigue in standing and walking, with late hours and the poisoned atmosphere of ill-ventilated places of business and dormitories, appear in such individuals to have contributed to the complaint. Undue strain upon a sound limb, in consequence of some other defect in the opposite limb throwing increased exertion and weight upon it, may produce this deformity.

[The treatment of knock-knee at present in vogue is, 1, gradual straightening, until the limb has assumed a shape approaching the normal one; 2, forcible straightening, according to the method of M. Delore; 3, osteotomy.

Gradual straightening is brought about by orthopædic apparatus, or, as has been recently suggested by German surgeons, the frequent application of plaster bandages with the limb brought straighter at each application.[1] Delore's method consists of forcible straightening under an anæsthetic. This is brought about by a separation of the epiphysis from the diaphysis, and in certain cases probably by rupture of the external lateral ligaments. In children this latter accident is not liable to occur. When it does occur recovery is delayed, and orthopædic apparatus will be probably needed as a support in locomotion for a time.

Fig. 730.



Apparatus for knock-knee.

As an aid in fracturing, an osteoclast has been used, or mechanical means to increase the amount of force used.

The method of forcible straightening after section of the external lateral ligament is one which should be discarded, as better means are now at the disposal of surgeons. Langenbeck, who previously advocated and practised the procedure, reports that it is almost impossible to prevent the entrance of air into the joint, a risk which is not incurred by other methods.[1]

Forcible straightening has, in the hands of Delore, Tillaux, and Duplay, brought about good results; in certain cases, however, the results have been unsatisfactory; in a few inflammation of the knee-joint followed, and a death has been reported.[2]

Osteotomy, in treating the deformity of knock-knee, has, within the last few years, been performed by German and English surgeons a great number of times, with reported remarkable success.

The method of Meyer, Billroth, and Schede of straightening the limb by section of the tibia has met with disfavor, as the internal condyle is in this way disregarded. Mr. Ogston, to remove this deformity, sawed off the internal condyle with an Adams saw, completely severing the internal condyle from the femur. Mr. Reeves has substituted the chisel in place of the saw, driving the former nearly into the joint, and completing the separation by a fracture which occurs on straightening the limb. In both these procedures the internal condyle is forced up. MacEwen and Chiene have made a wedge-shaped opening across the internal condyle by severing the femur from the inside, using chisels of different thicknesses, the largest being used first; the limb is then straightened forcibly. In some cases, MacEwen has found it necessary to chisel the tibia also. MacCormac entered the chisel on the outer side of the femur just above the line of the epiphysis; the chisel is driven nearly through the femur, the limb is then straightened, and the uncut part of the femur broken. A wedge-shaped gap is left on the outer side, which fills with granulations. Taylor and Barwell divided the femur above the knee-joint, Mr. Barwell chiselling also the tibia a short time afterwards. The joint is opened in Ogston and Reeves's operation; in the others it is probably not touched. In successful cases the patients are able to walk about in from three to six weeks. Success is obtained in by far the greater number of cases, the risk of Ogston's operation being comparatively slight, judging from the few deaths out of the many hundred reported cases. Some of Mr. MacEwen's patients have been able after recovery to walk thirteen miles at a stretch, thus proving the completeness of the cure.

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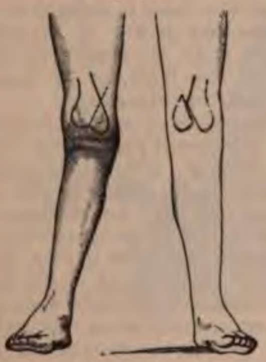
[1] Mikulicz, Langenbeck's Archiv, 23, 1877; Baker, Brit. Med. Journ., May 22, 1880; Fisher, Lancet, 1877, p. 84; Brodhurst, Lancet, June 7, 1879, p. 812.]

[1] Berl. Klin. Wochen., No. 40, 1877, p. 592.]

[2] Delore, 1861, Gaz. Méd. de Lyon, and Gaz. des Hôpitaux, Aug. 10, 1880, p. 730; Mikulicz, Langenbeck's Archiv f. Klin. Chir., 28, 1879; Gay, Lancet, Nov. 2, 1878, p. 620, Brit. Med., Nov. 23, 1878, p. 769; Tillaux, Bull. de la Société de Chir., Nov., 1875, also Bull. de la Société de Chir., ii., p. 559, 1876; Gaz. des Hôp., Aug. 10, 1880, p. 730.]

Fig. 731.



Dr. Ogston's operation for knock-knee (Bryant).

Although the number of deaths from Ogston's operation is remarkably small, yet the method of supra-condyloid osteotomy, with antiseptic precautions, offers the patient the best chances for the speediest recovery. The limb immediately after the operation should be fixed, and the most thorough fixation is given by a plaster-of-Paris bandage, with a fenestrum for the application of dressings.[1]]

Treatment of knock-knee.—We have heard it maintained, that, as a rule, children recover spontaneously from this affection. In a small proportion of cases, spontaneous recovery of good power of walking takes place; but an examination of such instances has shown us evident traces of the affection in some persistent enlargement of the internal condyles, with inability to take long walks on several successive days, without weakness and pain on the inside of the knee. Slight cases will recover under improved dietetic and hygienic influences, with the aid of suitable manipulations, and the discontinuance of prematurely teaching the child to walk. Sometimes we can, in addition, advantageously recommend the recumbent posture during certain short periods of the day, and combine with this repose the placing a soft pad between the condyles, the limbs being extended, and the ankles being gently drawn towards each other by means of a soft bandage, strap, or other ligature. In carrying out this plan, we require to watch that the knees be not too fully extended, *i. e.*, bent backwards beyond the horizontal line of the couch; a condition apt to ensue as another consequence of undue laxity of articular ligaments. In worse cases, more persistent mechanical means are requisite; simple padded wooden splints, a short one applied behind the knee to prevent flexion, and a long one reaching from the trochanter to the malleolus externus, not too tightly bandaged, may suffice. Modifications of such splints, constructed of metal or wood articulated at the knee, furnished with a ratchet-screw to permit adjustment to the inward inclination of the knee, and secured by straps and buckles, may be found at most instrument-makers. On the whole, even in moderately severe cases, but especially in aggravated cases, no apparatus is so efficient as a well-constructed iron to extend from the pelvis, on the outer side of the limb, sometimes on both sides of the limb, to the bottom of the shoe, the hip and ankle joints being left free, the knee *fixed* in a somewhat improved position, which may be further rectified from time to time, as the progress of the case demands, by means of the adjusting screw or straps. The surgeon should see that the apparatus is constructed with due regard to the anatomico-pathological and the mechanical wants of the case. For example, irons, to be promptly effective, need to take suitable points of support against the upper part of the outside of the thigh and the lower part of the outside of the fibula.

Severe cases require the knee to be prevented from bending when standing, during a period varying from three to six months; then freedom of motion during a part of each day for a similar though variable period; and, lastly, perfect freedom yet a few months, before discontinu-

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[[1] Annandale, Ed. Med. Journ., July 18, 1855; Ogston, Edinb. Med. Journal, March, 1877, p. 782; Langenbeck's Archiv f. Chir., 1877, Bd. 21, 237; Chiene, Ed. Med. Journal, Sept., 1877, p. 260; Reeves, Brit. Med. Journ., Sept. 21, 1878, p. 431; MacEwen, Osteotomy, London, Churchill, 1880; Barwell, Brit. Med. Journ., July 12, 1879; Poore, New York Med. Record, April 10, 1880, and ibid., May 22 and 29; also Sprengler, Centralblatt f. Chir., 1878, No. 12. Death after Ogston's Method, Lancet, Nov. 6, 1878, p. 696, and successful cases; Fowler, Proc. Soc. County of Kings, June, 1879, p. 119; Bruns, Berl. Klin. Woch., No. 33, 1880, p. 610; Davy, Lancet, Dec. 4, 1880, p. 896; Swan, Dublin Journal Med. Sc., Dec., 1880; Brodhurst in opposition, Lancet, Nov. 27, 1880, p. 870; Bradford, New York Med. Journal, Jan. 1881, one case treated by apparatus, one by osteotomy; also MacCormac, Antiseptic Surgery.]

ance of the support. The total average duration of bad cases in advanced childhood may occupy two years. Care should be taken to employ daily frictions and manipulations, so as to prevent the knee becoming stiff in an extended position. We were formerly accustomed, in severe in-knee of adolescents, to aid the mechanical treatment by previous section of the outer hamstring; but the observation of the length of time occupied in the treatment notwithstanding the tenotomy, and indeed a conviction forced upon us that the operation did not appreciably shorten the treatment, has caused us for many years past to discontinue recourse to it. In adolescents the most severe cases will recover with the aid of manipulations, exercises, and mechanical apparatus, without confinement to the couch; but until a straight limb is obtained, recumbency, by removing the weight of the trunk, greatly accelerates recovery. We are bound emphatically to protest against the operation of removal of a wedge-shaped piece of bone from the upper part of the tibia, performed by M. Meyer for the cure of this deformity. It is a sufficient condemnation of this severe operation to remind the reader that knock-knee is not dependent on curvature or deformity of the tibia, but upon a removable displacement of the relation of the articular extremities which enter into the knee-joint. Consequently, an operation of the kind performed away from the joint is at best a clumsy proceeding, and not without danger. Division of the external lateral ligaments, another operation recommended for knock-knee, is also unnecessary. [See p. 362.]

Occasionally the knee joint yields outwardly instead of inwardly, constituting a deformity exactly the opposite to knock-knee. We have named this affection, *Genu extrorsum curvatum*. The treatment of it should be conducted upon the same principles as that of knock-knee.

[*Curvature of Bone.*

A certain number of the curvatures of the long bones in young children correct themselves without treatment. In others the deformity increases with growth. Horst,[1] in fourteen cases under observation from four to nine years but subjected to no treatment, found that in nine cases there was an increase in the deformity, in four no increase, and in one improvement. Of cases treated by apparatus, in none did an increase of the deformity take place; in sixteen improvement was observed, the improvement being most marked when the curve was greatest and between two and three years of age. In some no improvement took place under treatment, but in these the curvature increased after apparatus was abandoned. Apparatus was worn in the successful cases from nine months to two years, and no injury to nutrition was observed from the use of the apparatus. This has also been the experience of Dr. Gibney.[1]

Where the bone is so hard as to resist the correcting power of apparatus, the deformity may be corrected either by section of the bone, or by breaking it, —osteotomy or osteoclasis.

The operation of osteotomy has won for itself a prominent place in the records of modern surgery. MacEwen has performed osteotomy on 557 limbs in 330 patients. Of these 220 were knock-knee, 64 were simple bow-leg, 40 patients with 80 limbs had anterior and other curves, 6 were patients with ankylosis (1 of the hip and 5 of the knee). Both limbs were operated on at once, and when several curves needed treatment, sections of all were made at the same time. In one case ten osteotomies were done at one sitting. These operations were not subcutaneous; the soft parts were divided down to the bone, and the chisel inserted at right angles to the axis of the bone. Strict antiseptic precautions were enforced. All the above patients except 8 recovered without suppuration. Of the 8 with suppuration, 7 recovered, after slight delay, 1 got out of bed shortly after the operation, stepped upon the limb, forced the bone through the skin, sloughing followed and amputation was performed; of those operated on, 3 died subsequently, 1 of pneumonia, 1 of diphtheria, 1 of tubercular meningitis. The others recovered with perfectly useful limbs.

Instead of removing a wedge-shaped piece of bone from the convexity of the tibia and fibula, it is a much simpler operation to divide with a chisel the fibula and tibia, and straighten the limb, leaving the wedged-shaped gap to fill up, which it appears invariably to do. The tibia should be divided at the point of its greatest curvature, and the fibula at the same level. Separate incisions should be made over the tibia and fibula, and the chisel inserted and turned so as to be at right angles with the incision made in the axis of the limb. The chisel should be $\frac{1}{2}$ to $\frac{3}{4}$ of an inch wide and should taper equally on both sides. Antiseptic precautions do not appear from the reported cases to be essential to success (Poore).

Instead of the chisel a subcutaneous saw has been used and is preferred by some surgeons. These deformities have also been corrected by fracturing the limb, by the hand or by the aid of an

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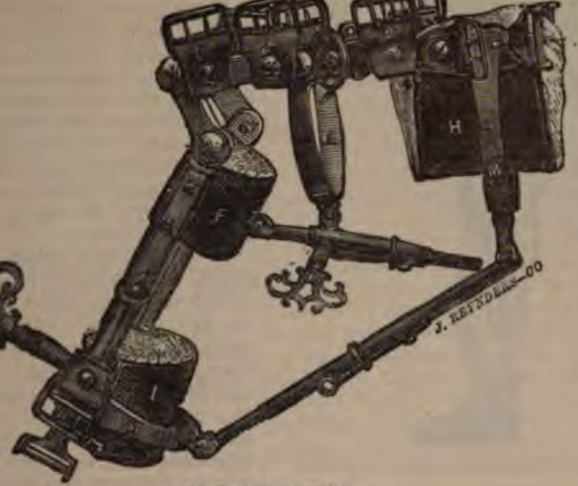
[1] New York Med. Journal, May, 1878, p. 544.]

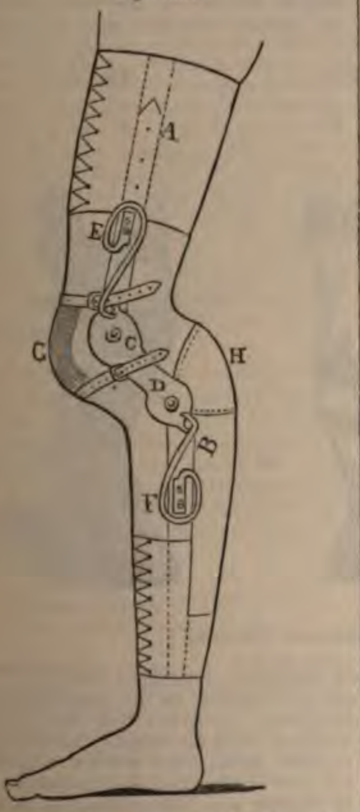
[1] Maryland Med. Journal, May, 1879.]

Fig. 732.



Shaffer's knee-splint.

Fig. 733.



Bigg's apparatus for restoring position after extension of contracted knee-joint (Erichsen).

osteoclast. The soft parts have been found to stand without injury a great deal of pressure, sufficient in the majority of cases to break bone. Immediately after the fracture the limb should be held in the corrected position by means of loops of bandage pulling in different directions and held by assistants, who should hold the limb also by the toes and knee. A bandage should be applied smoothly, cotton placed over the parts least covered with soft tissues, and plaster-of-Paris bandages applied. Swelling does not occur if the bandage is well applied, and no further treatment is needed until union takes place.

The danger from this procedure appears to be very slight. At an autopsy in a case reported by Dr. A. T. Cabot, where death took place from tubercular meningitis some time after osteotomy, it was found that fracture had occurred without splintering, and firm union had occurred without deformity.[1]]

On Orthopædic Operations applicable to the Removal of Curvature of Bones.

Under the section on Rachitis in this work the value of mechanical treatment

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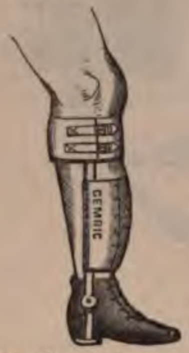
[[1] Boston Med. and Surg. Journal, Aug. 14, 1879, p. 217; Gussenbauer, Arch. f. Klin. Chir., xviii., 1875; Guérin, Gaz. Hebd., April 7, 1876; Barwell, Lancet, Dec. 23, 1877, p. 922; Bradley, Lancet, vol. ii., 1877, p. 78; Schede, Berl. Klin. Wochenschr., 1877, No. 36, p. 532; Maunder, Med. Times and Gaz., Feb. 2, 1878; MacEwen, Lancet, Dec. 28, 1878, Ibid., Sept. 18, 1880, p. 450; Billroth, London Med. Record, Oct. 13, 1875; Jones, Lancet, vol. ii., 1877, p. 235; Poore, New York Med. Record, April 26, 1879; Boeckel, Considerations sur l'Osteotomie, Paris, 1880; Albert, Wiener Med. Presse, Sept. 16, 1877, 3 cases, removal of wedge-shaped portion of tibia.]

of curvature of the long bones of the lower extremities will find appropriate mention. In very early childhood, whilst the curved bones are still in the softened stage, the straightening of them with the aid of splints, strapped or bandaged on the parts, may, when the treatment is conducted with gentleness and patience, be successfully accomplished, or "irons" may be substituted for splints. The bent rachitic bones of the forearm may also, in the early stage of the disorder, be straightened by splints or with the help of spring instruments. So also the long bones of the lower extremities in adolescents affected with the singular and pathologically speaking little understood disease variously denominated "mollities ossium, osteomalacia, rachitismus adultorum," may be easily straightened by mechanical means.

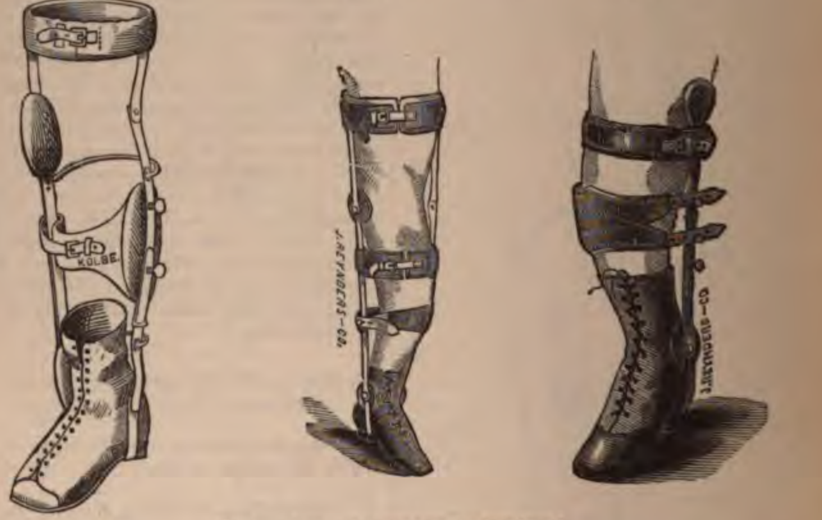
[Fig. 734.



Bigg's apparatus for anterior curvature of leg.]

It is different when, in ordinary rachitis, the bones have reached the stage of normal induration or "eburnation." On such bones mechanical pressure makes no perceptible impression. In the adult, therefore, affected for instance with tibia and fibula of ivory hardness, and bent to an angle of 75° or 80°, the limbs being shortened several inches, the act of walking being laborious and painful, owing to the consequent and undue strain upon the ankles and knees, which become effected with genu valgum and talipes valgus spurius or flat-foot, the question has arisen whether such an individual, insusceptible of help from irons, shall be left incurably lame.

[Fig. 735. Fig. 736. Fig. 737.



Various forms of appliances for bow-legs.]

A case of this nature was submitted for my opinion by Mr. L. Stromeyer Little. The case was that of a young adult female, otherwise in good health, and free from deformity in the upper half of the frame. It was agreed that relief might be obtainable from removal of wedges of bone from the tibia and fibula, and subsequently placing them in the straight position, and their treatment after the manner of accidental compound fracture. The difficulty in deciding on the propriety of such an operation resulted from the uncertainty whether bones thoroughly "eburnated" after rachitis could, when severed surgically, for the cure of distortion, be confidently expected to reunite after the manner of an ordinary compound fracture of healthy bone. No known facts bearing on this point, such as the history of a fractured rachitic "eburnated" bone and its reparation, were available to help the decision. After reflection upon the manner in which reparation is effected after fracture of a healthy bone, it was decided that reunion of the artificially divided eburnated bones would take place. The operations took place at the National Orthopædic Hospital. The tibia and fibula of each leg were severed and wedge-shaped pieces removed, the periosteum having been scrupulously respected as much as possible.

The operations presented no unexpected difficulties. They were arduous, owing to the depth at which great part of the sawing had to be accomplished, and the blunting effect of the hardened and enlarged bones upon the best tools. The leg first operated on did not heal without the supervention of two moderate abscesses, and the throwing off of small necrosed particles. The health did not suffer. After six months the patient left the hospital with one straight limb, the inversion of knee and flat-foot having been simultaneously overcome. She returned to the hospital after six months' absence and requested to have the second limb operated on. The experience acquired by the first operation was not lost upon the second. This time she made a more speedy recovery and had no abscess. A year and a half after the first operation she walked with the help of a stick, having two straight limbs.

Mr. Little operated on an analogous case of bony curvature in the upper extremity. A boy suffered from inability to pronate the forearm, owing to the bones having become deformed during infancy from softness and irregular muscular contraction. The forearm was constantly fixed in a state of supination, diagnosed to result from the unduly arched radius being locked in its movements by contact with the ulna. Section of the radius, placing it in a normal position, and healing of the artificial compound "solution of continuity," resulted in a few weeks without any disturbing symptom and with the desired beneficial result.

These operations, fairly indicated and eminently successful, offer an encouraging page to the orthopædic surgery of bones. As in other departments of orthopædy, it may be hoped that increased attention to such deformities in their early stages may render the opportunity of important surgical interference less frequent than we have witnessed.

Ankylosis of the Knee and other Articulations.

The successful labors of orthopædic practitioners have contributed to improve the knowledge of the real condition of joints after the cessation of various forms and degrees of inflammation and degeneration. The erroneous notion, that long-continued repose of a joint alone sufficed to induce such alterations in its articular surfaces as to lead to bony union, and the remarkable rigidity and immobility which result from the agglutinated or contracted extra-articular structures—fasciæ, muscles, and ligaments—especially when dense, fibrous, deeply-extending cicatrices coexist, favored the supposition of the common prevalence of true bony, irremediable ankylosis. We know that absolute bony union of articular surfaces is a comparative rarity, even in pathological cabinets.

For practical purposes we may divide the conditions in which joints contracted from disease are presented to the surgeon, with a view to the restoration of form and motion, into three classes. 1st. Those in which the resistance to motion is furnished solely or mainly by the extra-articular tissues. 2d. Those in which, in addition, more or less considerable changes within the articulation have occurred, viz., transformation of the synovial surfaces, vascular adhesions, fibrous adhesions, erosion of cartilage or of bone, mineral or bony deposits. 3d. Absolute osseous ankylosis.

The first class of cases is common. We have met with numerous instances of knee and elbow-joint contractions, induced respectively by severe, deeply-extending burns, by phlegmonous erysipelas, by "swelled leg," in which the history of the case, the state of obvious contraction and adhesion of the extra-articular tissues, together with the absence of displacement or deformity of the articular extremities of the bones, left no doubt in our minds that the articular surfaces, notwithstanding the paucity of motion, or its entire absence, were free from organic change. In these cases, restoration of form, and often an almost complete recovery of spontaneous, *i. e.*, voluntary, movement, may be effected without difficulty.

The second class of cases includes some which have had a similar origin to those of the first category, but in which the injury or inflammation has extended to the interior of the joint, or at least has involved the capsular ligament. In these cases, deep, retracted, indented cicatrices, and bands of indurated adventitious tissue, penetrating, it may be presumed, into the hollows and sinuosities of the ends of the bones, even if all happen to be exterior to the articulation, tell of exposure of the synovial membrane so near to the disease, that it is improbable that it will have escaped. These cases admit of rectification of position, and commonly some degree of voluntary motion follows, but not always until months or years after active orthopædic treatment has been discontinued. The bulk of the second class consists of cases resulting from strumous synovitis (?) and diseases of the articular extremities, rheumatic and gouty contractions, and distortions from accidental violence.

The strumous distortions of the knee usually present considerable mobility within a limited range, with much deformity and prominence of the internal condyle from subluxation, and from wasting of the member above and below the articulation. They are usually straightened without difficulty, although much prominence of the condyles and subluxation will remain. Partial mobility is usually recovered.

The rheumatic cases which apply for orthopædic relief are principally of two kinds, those in which "chronic rheumatic arthritis" subsists, and those rarer instances of acute articular inflammation excited by exposure to cold during gonorrhœa, childbed, or an early stage of lactation. In the first kind, during the comparatively early stage, much intra-articular fluid secretion and free mobility within a certain range remain. At a later stage, in proportion to the development of gelatinous and vascular adhesions and mineral deposit, the movement becomes more limited. Before and subsequently to the appearance of Bonnet's work, Thérapeutique des Maladies Articulaires, we have been accustomed to attempt, by gentle manipulations and gentle but firm employment of mechanical contrivances, to restore these limbs to greater usefulness as regards movement and symmetry. We have succeeded in obtaining the latter, but not the former desideratum. In fact, as might be inferred from correct pathological knowledge, the benefit of orthopædic treatment is in the inverse proportion to the anatomical degeneration which the rheumatic joint has undergone.

In the second kind of rheumatic cases of partial ankylosis, those which have commenced with very acute affection of one joint, most often the knee, the loss of motion occurs rapidly, and is frequently complete. It seems, in these cases, that an acute destruction of the synovial surface, with rapid exudation of mortar-like plastic material, takes place, causing firm agglutination of the ends of the bones.

Tact in the examination will usually show that absolute immobility of the knee, from whatever cause the ankylosis has proceeded, does not exist. The surgeon can with certainty determine that the joint is movable if an energetic effort to bend or straighten the limb produces a sharp pain through it. We may deduce some favorable conclusions as to the state of the joint if we find the patella movable. This bone may sometimes be moved upon its perpendicular axis when no motion is perceived upon the horizontal one, and when no flexion or extension of the knee can be effected by ordinary handling of the joint.

We make no other mention of stiffness of joints from common articular rheumatism, acute and chronic, than to observe, that as this affection usually leaves the synovial membrane intact, no deformity, as a rule, remains, the exception being the ankle; here the weight of the body comes more mischievously into play than elsewhere, and sometimes gives rise to a rheumatic in-ankle or flat-foot.

Many rheumatic contractions, those which are the least amenable to treatment, belong to the peculiar form of the disease denominated "chronic rheumatic arthritis" by Adams, of Dublin, the "rheumatoid arthritis" of Garrod.

As a rule, in reference to orthopædic treatment, a correct judgment of the condition of a joint contracted from disease may be formed from the history and the external appearance, aided by careful manual examination. In the hip, the diagnosis is sometimes more difficult, because the history communicated may be fallacious, in consequence of the greater liability to errors in diagnosis during the first stage of disorder in and around this articulation. Thus we have seen hip-contractions in which the primary hip-affection had been originally sciatica, muscular, and fascial rheumatism of the bulk of muscles of the hip and loin, or one of the forms of rheumatism of the joint itself, or "morbus coxæ," or the result of accident. To these causes of hip-contraction, which are not always diagnosed, we may add the peculiarly grave intra- and extra-articular exudation which occasionally occurs at the close of malignant scarlatina, and the less serious persistent drawing up of the thighs which occurs (without pyæmia) during a tedious confinement to bed from fevers and phlegmasiæ, especially in persons whose growth is not complete. We have also met with rigid hip-contraction, with pain and wasting, which had commenced during pregnancy, from uterine influences; also after childbirth, from puerperal disturbance; and in unimpregnated, as well as in unmarried women, even from great fecal accumulation in the intestines. Whilst reminding the surgeon of the various causes of persistent hip-contraction, we may complete the list by adding congenital contractions and luxations, paralytic and spasmodic contractures, some of these being hysterical, and some very grave affections, proceeding from disease of the brain or spinal cord, sometimes coexisting with angular spinal curvature. We have not enumerated these numerous causes of hip-contraction, as if they were so many pitfalls to the surgeon; but in order that, knowing what may have produced a given contraction, the young surgeon may be forearmed for diagnosis and successful treatment.

Treatment of partial and complete ankylosis.—The several forms of contracted joints of the extremities above enumerated admit of three modes of treatment: 1st. Mechanical extension, including manipulations and shampooing. 2d. Tenotomy, succeeded by gentle, gradual mechanical extension. 3d. Violent extension under the anæsthetic influence of chloroform, sometimes preceded by tenotomy.

The majority of joints affected with incomplete ankylosis, even the knee, elbow, or hip, still more the smaller articulations, and even after three or four years' duration of the contraction, admit of as full and prompt restoration by gradual, gentle employment of mechanical extension as by either of the remaining modes of treatment above indicated, with the advantage of the treatment being conducted without pain, suffering of any kind, or confinement to the house. In severe knee-cases of many years' duration, subcutaneous division of the hamstring muscles may advantageously precede the mechanical treatment, the surgeon bearing in mind that here, as in other distortions, success depends more upon the manner in which the mechanical treatment is conducted than upon operative interference. In a small proportion of cases, those in which apparent total immobility exists, or in which it is obvious that partial calcareous deposit has taken place, violent extension, with the aid of chloroform or ether, may be employed. We annex a few detailed observations on the mode of conducting each of these processes.

Mechanical extension of partially ankylosed joints.—Long experience in the use of mechanical apparatus shows how little actual apparent power is required to overcome the most rigid contractures of joints. The first condition of success is the correct adaptation of the appropriate apparatus to the size and natural movements of the part. It is of much importance also, that, when practicable, the apparatus should only limit the movement of the affected joint towards the contracted side, *i. e.*, it should not immovably fix the part in every direction, but should leave some "play" to the limb in the direction which it is wished the part should take. No curable ankylosis, free from bony union, can resist gradual, gentle pressure; we only resort to tenotomy, in addition to mechanical extension, for the purpose of saving time. A little consideration will explain how apparently slight continued pressure can effect so great a result as the straightening of a knee contracted for twenty years from former articular disease or injury. The uninitiated surgeon is accustomed to regard such a joint as "nearly ankylosed;" perhaps he does not reflect that, if bony union have not taken place, the opposing structures are "soft parts," *i. e.*, shortened muscles, ligaments, fasciæ, cutaneous textures, and cicatrices, all liable to yield to steady pressure. It is probable that as soon as this gentle pressure is applied, the contracted muscles, shortened merely from position and repose, *not being spasmodically affected*, resist elongation, but they speedily tire, and give up the unequal struggle; the non-muscular parts, however dense they may be, probably undergo some change of vascularity, some interstitial change in their nutrition as a consequence of the *gentle violence* they undergo, through which their mechanical power of resistance is diminished. An increase of temperature and of bulk of the part undergoing mechanical extension is usually perceived, which we believe to be due to increased flow of blood consequent upon the stimulus of the state of tension in which the resisting tissues are maintained. This augmented flow of blood is unaccompanied by inflammation or even by pain when the part is at rest. Such appears to be the process in the structures on the contracted side of the member. The treatment probably receives aid from the muscles on the uncontracted side. The direction of the distortion was originally determined by the stronger set of muscles, or by those most advantageously situated, having overpowered the weaker set. When the contracted muscles yield in their turn to the mechanical instrument, the muscles situated on the uncontracted side tend to recover their lost sphere of action, and assist replacement.

The knee-joint, being a simple hinge, while the thigh and leg each offers a great length of leverage, is advantageously formed for successful orthopædic treatment by mechanical extension; and consequently we meet with no partially ankylosed knee which cannot be straightened and rendered fit for use, without the aid of tenotomy or chloroform, in a period varying from one to three months.

The anatomical relations of the hip-joint render it less favorable for orthopædic treatment than any of the ginglymoid articulations. At the hip, the shortness of the lever afforded by the small depth of the pelvis, and the difficulty of fixing the pelvis, explains why, when power is applied to the thigh with the view of extending the abnormally flexed or contracted hip, the lower part of the vertebral column, back, and loins, yield anteriorly, causing an extreme hollow in the loins (lordosis). In fact a small part only of the power employed is effective on the contracted hip-joint, the greater part being expended in dragging forwards the lowest dorsal and the lumbar vertebræ. We may mention, in illustration of the comparative difficulty of straightening the hip, that in an instance of uniform fibrous and vascular membranous adhesion of the head of the femur within the acetabulum after death, the partially ankylosed pelvis and thigh having been removed from the body, we were unable to extend the hip by any power we could exert with our hands, until the capsular ligament and some of the adhesions within the acetabulum had been severed with the knife. The same kind of adhesions in a knee would have yielded to the power fruitlessly employed at the hip.

Great ingenuity has been displayed in the manufacture of the apparatus. Occasionally considerable demands upon the skill of the mechanist are required. The continued attention of orthopædic practitioners who, during the last five-and-twenty years, have trodden in the footsteps of Scarpa and Stromeyer, bringing pathological and anatomical knowledge, with experience, to the aid of the instrument-maker, has revolutionized, simplified, and thus far perfected orthopædic apparatus. As a general rule, elaborate instruments should be avoided. They are often strictly articles of luxury, not obtainable for the treatment of the majority of cases that present themselves in private, and especially in public practice. We may affirm that when *nothing* can be effected for the relief of a deformity without a complicated instrument, very little can be effected with its assistance. Yet in numerous instances, as in congenital club-foot of adolescents, in considerable knee-contractions, and subluxation, the necessity of well fixing one part whilst another is acted upon, or the complicated character of the deformity itself, entails corresponding need of an elaborate contrivance.

Different mechanical forces are employed—the lever, the screw, and the spring; the last two often resolvable into the lever, screws and springs being employed to modify the action of the lever. The discussion of the relative advantages of the different modes of applying these forces would lead us away from our immediate object.

It should be borne in mind during the employment of these forces in orthopædic apparatus, and especially in the use of the screw, that it is available less as a means of abruptly forcing the deformed parts into their natural position than as an adjusting contrivance. In any case in which the screw is *forcibly* employed, unless for a very brief period, excoriation, sloughing, or intolerable pain, will inevitably result. In some *patient* individuals, vesication, and even superficial sloughs, may be induced over projecting bones without complaint of pain—an urgent reason for anxious examination of a part subjected to pressure, especially by the inexperienced orthopædist. Large sloughs are more than inexcusable.

Every apparatus should be padded, so as to avoid pressure upon prominent points of the bone, and adapted to each individual case. The orthopædic apparatus, like that for a fractured limb, should compress the part in its circumference as little as possible, and never tightly encircle it. It should act gradually, *in proportion as the deformity itself changes its form*. We have endeavored in our previous remarks to show, that if a contracted member,[1] a knee for example, is evenly secured in a suitable apparatus, accurately adapted to the degree of bending of the joint, the processes which ensue in the joint when a moderate tension is imparted soon favor the moving of the joint in the direction contrary to that which it may have long maintained. A contracted knee resting upon its posterior aspect in an apparatus, tends by its own weight to regain a straighter position.

At the outset, the surgeon should be content simply to apply the instrument to the deformity, and not to apply the deformity to the instrument, as is too often attempted by novices in orthopædic practice. In this gentle manner of proceeding, the first difficulty in the treatment of every case of deformity is overcome,—the patient suffers nothing from the attempt to straighten the part; the simple inconvenience of wearing an apparatus, the irksomeness attendant upon necessary confinement of the affected part in an unfamiliar instrument, is his only trouble, and one which is speedily, in a day or two, overcome. Having once applied a well-fitting instrument, the screws or straps by which it is adjusted to the now improving member require to be advanced or tightened as opportunity offers. An impatient advance of the pressure will, by production of pain, and necessity for relaxation of the instrument, occasion loss of time. The principle of action in the progress of mechanical treatment should be that of never advancing too rapidly, so as to risk the necessity of receding. By gentle means, and uniform steady advance, the patient's confidence, so essential to prompt recovery, remains undiminished. By subjecting the member to no greater pressure than can be easily borne, no temptation to loosening the apparatus is afforded to the timid, and no risk is incurred of occasioning excoriation or inflammation in individuals possessing greater endurance, or in young children, whose cries may be attributed to other causes. In this manner, in suitable cases, the opposition offered to restoration by fasciæ, tendons, ligaments, and ill direction of articular surfaces, apparently irresistible, may, with the further aid of manipulations, be removed.

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[1] The greater number of contracted joints, when not affected with bony ankylosis, if left to themselves, may be regarded as contracting joints; for the contracting process is ever progressing until it attains the maximum.

In the choice of mechanical apparatus the surgeon should also be guided by that principle which actuates him in the selection of therapeutic agents in any internal or external disease, viz., the use of that means the action of which he best understands, or in the use of which he has had most experience. A common splint, properly applied, will effect more benefit than an instrument of greater pretension indifferently managed.

From all these considerations, it is apparent that much harm will result, in the great majority of deformities, from the habit sometimes pursued of keeping a deformed part many weeks in succession in an apparatus without the removal so necessary for the purposes of cleanliness, manipulations, and readjustment. Among the evil consequences of too long retention of instruments, often combined with unsuspected excessive pressure, the author has witnessed the production of an opposite kind of deformity, as the conversion of varus into valgus, and a degree of rigidity of the part, which has required weeks of painful manipulations and stretchings, before the natural movements have been possible — sometimes, indeed, restoration of motion of an articulation has been rendered impossible.

The slighter the deformity, the more necessary is frequent removal of the apparatus, because by removal and appropriate manipulations we insure retention of mobility. In severe cases, in which we expect only to effect straightening, and do not anticipate restoration of mobility, frequent removal of the apparatus is unnecessary; for too frequent removal may be hurtful, by allowing the recently elongated tissues to recontract during the time the apparatus is removed from the part.

Division of the hamstring muscles.—We have shown that in a limited number of knee-contractures from disease and accident, section of the hamstring muscles may be required as a preliminary to gradual mechanical extension, or to abrupt violent extension under chloroform. In all cases after tenotomy, extension, whether gradual or abrupt, should be delayed until the healing of the punctures in the integuments. In the knee this healing is seldom complete until four or five days after the operation. The following rules may be given for severing the hamstring tendons: Place the patient in the prone position, and let an assistant make firm extension upon the joint, or desire the patient to endeavor to bend the knee, by either of which means the tendons will be rendered prominent. In general follow the directions laid down for the division of the tendo Achillis (p. 338). In severing the tendon of the biceps femoris, insert the tenotome in the adult an inch above the apparent point of contact of the tendon with the fibula, remembering the proximity of the external popliteal nerve, and keeping, therefore, the tenotome close to the tendon. The semi-tendinosus being very superficial, is readily severed by a puncture, where it springs up most prominently; the semi-membranosus being more bulky and fleshy, as well as more deeply seated, requires a larger sweep of the end of the tenotome. It is scarcely necessary to recommend caution as to the important nervous, arterial, and venous structures of the popliteal region. After section of the inner hamstrings, the pressure of the assistant's hands upon the limb being continued, bands of fascia and nerves make themselves prominently felt in the ham. Troublesome numbness in the calf, and unusual pain during extension, has followed the unnecessary division of these structures. It is desirable to apply promptly a pledget of lint and suitable pressure by a bandage over the punctures, to prevent oozing of blood into the areolar tissue of the ham, which affords an inconvenient nidus for suppuration. By adopting this immediate covering and pressure over the puncture, we have never witnessed delay in healing beyond four or five days, in ordinary moderate temperature. Very cold weather may cause tenotomy-punctures in limbs of weak circulation to appear, at the end of several days, as if they had been effected an hour previously, no attempt at adhesion being made. It is therefore proper in cold weather to envelop the limb in flannel, and to assist the reparative powers of the patient by generous diet.

Forcible subcutaneous separation of the tibia and femur in true bony ankylosis of the knee-joint.—This operation, originally proposed and carried out successfully by Langenbeck, and Gross of Philadelphia, has been performed in this country, with some modifications, by Mr. Little, at the London Hospital. The operation consists in making a small incision in the integuments and fibrous tissues at the side of the articulation parallel to the plane of the natural articulating surface of the tibia. The length of this incision should correspond with the width of a narrow sharp-cutting, well-tempered ordinary chisel, say two or three lines in width, which being driven in different directions between the ends of the femur and tibia, united by osseous material, so effectually weakens the connection between the adherent surfaces, that straightening and bending of the limb can, with the exercise of "gentle violence" with the hands, be readily effected. When the surgeon remembers that the *joint* has been destroyed by the diseased process which produced the bony ankylosis, he will not be surprised to learn that this surgical subcutaneous chiselling asunder of bones is not followed by any of the serious consequences known to follow wounds of the joint, and that with or without simultaneous section of knee-tendons, as may appear requisite, the limb may be placed in the desired curative position. It may seem superfluous to remark that the operation is perfectly safe in the hands of the surgeon who avoids injury of the important nerves and vessels about the articulation. It cannot fail to become a standard operation for relief of knees affected with *bony* ankylosis in a bent position, and is in every respect infinitely preferable to the operation of knee-resection when it has been performed for mere ankylosis.

Division of muscles in the vicinity of the hip-joint.—Though in hip-contractures the majority of the muscles proceeding from the pelvis on the flexed side of the part are contracted, experience teaches that few require operative interference. We have many times severed the origins of the adductor longus, adductor brevis, and pectineus, the tensor vaginæ femoris, and the superior origin of the rectus femoris. But of late years we have commonly restricted the operation to the tendon of the adductor longus, for the relief of tense abnormal approximation of the thighs, in cases of general spastic rigidity of the lower extremities. The adductor longus, from its position, exerts a relatively greater influence in morbidly adducting the thighs than other muscles. Its division is a satisfactory starting point for subsequent benefit from manipulation and use. It is effected according to the general principles of tenotomy, and requires no particular description.

Section of the tensor vaginæ femoris and rectus is suggested in certain cases of paralytic contracture of the hip, in which atony of the adductors of the thigh exists, a state of things opposite to the last-mentioned kind of case. Here the thigh is drawn from its fellow, the trunk tending to fall to the ground, as it were, between the thighs. Where contraction of these muscles exists, the paralysis of the adductors and other muscles of the hip (psoæ and glutei) is usually so considerable, that little radical good results from the operation. It should, therefore, as a rule, be superseded by manipulations, frictions, and mechanical appliances.

Division of the flexor tendons of the fingers and toes.—The phalanges, when contracted from articular complaints, require treatment similar to that of the larger articulations. Commonly it is the flexor tendon which is implicated. Enough has been stated concerning the large ginglymoid articulations to render many details of treatment of these small articulations unnecessary. In operating on the fingers, we have to consider beforehand whether the articular disease has left the joint in a condition to resume its functions as to movement; for if we may not expect to recover mobility, a straightened finger is not preferable to one partly bent. We require also to calculate the chance of the tendon when operated on in the course of the theca becoming agglutinated to the theca, and the finger subsequently on that account not regaining movement. In the foot, the most frequent affections of the toes for which surgeons are consulted are those resulting from improper shoes worn during the growing period of the foot—in childhood and adolescence. The great toe is often thrust inwardly, and overlaps the next toe, the metatarso-phalangeal articulation being inflamed and ultimately deteriorated as to the normal condition of the articular surface, with consequent impairment of mobility and very troublesome lameness. [Hueter[1] advises that the head of the metatarsal bone be excised for the enlarged and painful joints caused by imperfectly-fitting shoes or other causes, giving rise to the deformity which is termed "hallux valgus." The disability may be so great as to prevent walking. This operation he performs by making a straight incision on the inner edge of the foot, cutting off the head of the bone with bone-forceps or saw, and bringing the toe into line. Dr. Hamilton, of New York, has reported eleven cases of this operation, with one death and ten successful cases; the results were satisfactory in the successful cases, and the disability more or less completely removed. The fatal case was that of an old gentleman, 75 years of age, who had suffered from an extensive disease of the joint with suppuration, for three years. Dr. A. N. Blodgett, of Boston, has performed the operation three times with complete success, union taking place by first intention, and with a cure of the deformity and disability.] The joint is inclined to stiffen in the extended position after subsidence of the irritation or inflammation, the individual being prevented standing tip-toe, or ascending a hill, without pain or inconvenience. This condition of things may, before and about puberty, be remedied by rest and suitable topical applications, followed by manipulations; the interposition of a partition between the toes, so as to keep the great toe in a proper line with the margin of the foot; and the temporary use of a suitably wide shoe. In long-standing cases, in which the extensor tendon of the great toe becomes rigidly contracted and structurally shortened, and has become dragged outwardly away from its normal situation above and parallel to the metatarso-phalangeal articulation, the section of this tendon may afford relief.

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[1] [Klinik der Gelenkkrankheiten.]

Another common troublesome defect in the toes, similarly produced, though sometimes hereditary, is fixed flexion of the second toe. In children under the age of ten or twelve years, this defect can usually be remedied by light gentle bandaging (not tight) of the part, upon a padded whalebone splint, night and day, for a few weeks. In older subjects, and in peculiarly rigid cases, section of the flexor tendon, opposite the first phalanx, followed by bandaging on the splint, is a prompt and certain means of cure.

The little toe is often extended upon the metatarsus, or thrust laterally and inwardly and sufficiently prominent to become continually a source of pain and irritation from the shoe. This also is often a congenital affection. Division of the extensor tendon, and bandaging, afford relief.

The toes, and particularly the great toe, are often contracted in cases of varus, congenital and acquired. These contractions are relieved by the means taken to cure the talipes, and sometimes by gradually improving their position with suitable bandages.

[The danger incurred in brisement forcé is, 1st, of fracture or separation of the epiphysis; dislocation; injury to the nerve; laceration of the skin; rupture of the artery. Of these, the most common is fracture, which occurred in 39 out of 119 of Nussbaum's cases. The danger of this is avoided to a degree by tenotomy, but not entirely. Brodhurst has employed forcible flexion in 260 cases, and has met with no accident of any sort. Bauer has used brisement forcé in 600 cases of contraction and ankylosis, with such success as to warrant his recommending this instead of gradual straightening. In a few cases, however, fracture has occurred. The femur has been purposely broken in deformity from ankylosis of the hip in a faulty position by Stanley,[1] Tillaux,[2] and C. F. Taylor.[3]

The latter employed in one case an ingeniously-devised osteoclast for the purpose, with an excellent result.

Rupture of the popliteal artery occurred in one case of forcible straightening of the knee, under the care of Dr. C. D. Homans; the femoral artery was tied, and the patient ultimately recovered.[4]

At the knee-joint, to diminish the resistance, it is always advisable, if possible, to loosen the patella before straightening the limb; this can sometimes be done by pressure from the outside by a key. Recently, however, the patella has been separated from the femur by a chisel, and also by a subcutaneous saw, and the limb successfully straightened.[5]

Rhea Barton practised the excision of a wedge-shaped piece of the shaft of the femur above the condyles, fracturing the bone remaining uncut. Buck modified this procedure by including in his wedge the condyles and the head of the tibia. Dr. Gross collected 21 cases of this operation, with 4 deaths from pyæmia. Pancoast, Brainard, Gross, and others have drilled through the bone, using a small drill, at the point destined for fracture, and then straightened the limb.[6]

For ankylosis of the hip-joint, with deformity, Rhea Barton performed section of the femur below the trochanter major. Sayre subsequently modified the operation by making the division with a chain-saw above the trochanter minor. Adams makes a section of the neck of the femur with a subcutaneous saw. He has collected 22 cases of his operation, with 2 deaths, one with pyæmia. One of Mr. Adams's cases was able two years after the operation to walk eight miles. The operation has been successfully performed also by Golding Bird, Jessop, Sands, Lund, and Bryant. Mr. Adams has never obtained motion after the operation, but this was gained in the cases of Jessop, Sands, and Lund. The operation is done as follows: the tenotomy-knife is entered a little above the top of the great trochanter, and carried straight down to the neck of the femur, dividing the muscle and the capsular ligament; a small

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[[1] New York Med. Record, July 10, 1880.]

[[1] Med. Times and Gaz., July, 1859.]

[[2] Union Méd., Nos. 27 and 29, 1876.]

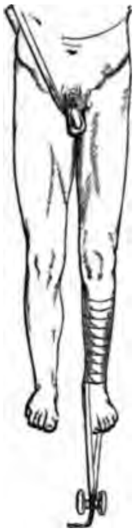
[[3] New York Med. Record, April 21, 1877.]

[[4] Boston Medical and Surgical Journal, Oct. 19, 1876.]

[[5] Richardson, Lancet, Aug. 4, 1877, p. 183.]

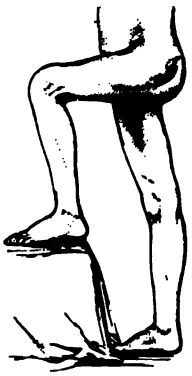
[[6] Sayre, Lectures on Orthopædic Surgery; Kilgariff, Dublin Journ. Med. Sci., March, 1880; Entrikin, Clinic, xii., March, 1876.]

Fig. 738.



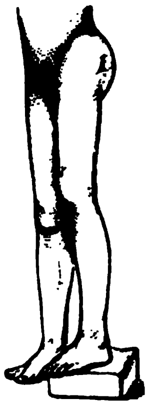
Treatment by weight and counter-extension, of hip-joint disease with dislocation (Bryant).

Fig. 739.



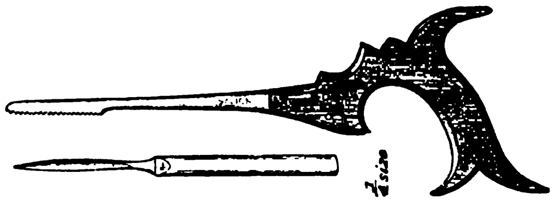
Ankylosis of hip-joint with femur at right angle to pelvis, before operation (Bryant).

Fig. 740.



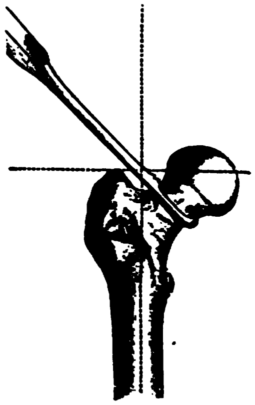
Position of the leg after Adams's operation (Bryant).

Fig. 741.



Saw and knife for performing Adams's operation (Bryant).

Fig. 742.



Drawing showing the line of action of the neck of the thigh-bone in Adams's operation (Bryant).

saw is carried along the track made, and the bone sawn through. A narrow chisel can be used instead of the saw. Gant, Golding Bird, Hamilton, Maunder, Croft, Brodhurst, and Porter have divided the femur below the trochanter, where it was impossible to define the neck to execute Adams's operation.

Volkmann[1] reports having performed subtrochanteric osteotomy 12 times, with entire success. In six cases he has performed resection of the hip, using the chisel to remove, after section, the head united with the pelvis, in order that no union may take place and the patient have motion. Success, with establishment of motion, is reported in all. He uses the strictest antiseptic precautions.[1]

[[1] Centralblatt f. Chirurgie, Jan. 31, 1880; also Ibid., April, 1874.]

[[1] Bryant's Practice of Surgery; Erichsen's Surgery; Sayre, Orthopædic Surgery, and New York Med. Record, March 2, 1878; Adams, Med. Chir. Trans., 2d series, vol. xlii.; Golding Bird, Guy's Hospital Reports, 3d series, vol. xxii., 1877; Brit. Med. Journ., Sept. 29, 1877; Ohio Med. Recorder, August, 1877; Brit. Med. Journal, Dec. 8, 1877; Trans.

Forcible extension.—Under the head of *manipulations* and stretchings, the value of *gentle* employment of pressure and movements with the hands (passive exercise), both as a means of curing slight deformities, and as an important auxiliary to other methods of treatment, has been shown. If a larger measure of pressure or force be used with the hands, the treatment becomes that denominated *violent extension.* Here, as elsewhere, it is difficult to draw an arbitrary line, and say where gentle manipulation ends, and violent extension begins. In the practice of manipulations, the competent operator may frequently avail himself of the smaller degree of sensitiveness displayed by some patients, or of the momentary abstraction of the patient's volition from the muscles (a circumstance instantly felt by the hand of the operator), and apply an amount of force which approximates to, or may be considered as, violent extension. But *violent* extension with the hands is rarely efficacious in the removal of considerable contraction and deformity, especially in full-grown persons, because either the pain produced is intolerable, or the voluntary resistance offered by the muscles of the patient exceeds that at the command of the operator; a struggle is maintained between the patient's muscles and the surgeon or rubber, in which the latter is commonly not victorious.

Through the inability of one person to effect, with any effort of his will, an extension forcible enough to overcome severe contraction, violent *sudden* extension, by means of the combined strength of several assistants, or by means of powerful screws, brought suddenly into action, was proposed and carried out, with varying success and misfortune, by Louvrier, Dieffenbach, and others. In the less severe cases of deformity, those indeed which are curable by gentler means, without longer duration of treatment, the parts were *suddenly* straightened by violent extension, without ultimately mischievous results, and the expected benefit was obtained. But in severer cases of deformity of many years' existence, in which organic changes of greater magnitude had taken place, as in severe knee-ankylosis from extensive suppuration about the articulation, with necrosis, the violent separation of adhesions, and snapping asunder of bony deposits in the popliteal space and elsewhere, were accompanied with laceration of bloodvessels and nerves, fractures of the bones themselves, and consequent inflammation, suppuration, and even mortification of the member. The plan was deservedly denounced, and fell into disuse.

Forcible extension under chloroform.—Surgery received an invaluable addition to its means of usefulness by the discovery of the anæsthetic properties of ether and chloroform; and orthopædic practitioners, following the example of Langenbeck,[1] promptly availed themselves of the assistance these means are calculated to render in the cure of deformities. Hence the employment of forcible extension with the aid of chloroform or ether. By chloroformization, the two great obstacles to the employment of force adequate to straighten or bend a contracted limb, namely, pain and voluntary muscular resistance, are removed. As soon as these impediments disappear, the hands of the single operator, and his single mind, applied to the parts, encounter the physical resistance only of the deformed parts; comparatively gentle manipulations now acquaint him with the nature and amount of difficulty; he can feel his way in the application of greater force; can feel and perceive the resistance of parts successfully overcome, in an anatomical order; if greater rigidity still oppose, a few movements of the joint backward and forward prepare the way for a more extensive yielding; and often the practitioner has the satisfaction of being able thus to effect every natural movement of the joint.

Chloroformization, with manipulations, and the use of a certain degree of force, may be of service as a means of diagnosis. By it the practitioner is enabled, in some degree, to ascertain what proportion of the deformity is due to shortening of soft parts, how much mischief the articular surfaces have undergone, and what amount of restoration is practicable.

After straightening or bending the limb, as the case may have required, by means of this forcible procedure, the part should be lightly secured in a retentive instrument or upon a common splint, adjusted so as to maintain a position more favorable than that in which the limb was before the operation, though not so as to keep it in the new position, *i. e.*, the entirely straight or bent position into which the hands of the surgeon may have brought it. For as soon as the effect of the chloroform disappears, the patient arouses to the conviction of the violence which may have been employed, the part may be acutely painful, and incapable of sustaining the pressure of a tight bandage or ligature.

We usually content ourselves with the

London Clinical Soc., vol. x.; Lancet, Dec. 22, 1877; Boston Med. and Surg. Journ., April 18, 1878.]

[1] Commentatio de Contractura et Ankylosi Genu, novo methodo violentæ extensionis ope sanandis. Berolini, 1850.

increased knowledge obtained of the nature of the case, with the satisfaction of knowing that the part can be improved in form and function, and as the resisting parts have once yielded, that they will afterwards oppose less resistance to replacement; whether the means subsequently employed should be simple manipulations, the use of mechanical apparatus, or repeated administrations of chloroform, and forcible extension. The surgeon who should attempt the forcible binding down of a long-deformed limb immediately after forcible extension, would betray a lamentable ignorance of the pathological condition of the parts in the immediate vicinity and within the diseased articulation. Although the muscular structures may have yielded under chloroform, and indurated fasciæ and old adhesions may have been overcome by stretching and tearing, it will be remembered that much adaptation on the part of nerves, bloodvessels, and absorbents to the altered position of the structures, needs to be accomplished. We find that, by taking moderate means of retaining as much improvement after the forcible extension as can be borne by the sufferer, by the unsparing use of lotions of spirit or by ice applications, and by the internal use of morphia, dangerous inflammation of joints thus straightened has been averted. By employing afterwards the ordinary means of gradual extension, we have straightened joints which would otherwise have required many months of ordinary treatment.

It is perhaps not superfluous to remark, that the use of forcible extension is less defensible in cases of recent disease of articulations than even other active attempts to restore the form in such cases. In a diseased joint the practitioner has to note not only the local disorder, but also the general condition, of which the local affection is but one manifestation. When the surgeon, with ability and experience, has cured the local disorder, *i. e.*, removed the inflammation, healed the ulcerated or suppurating parts, or effected subsidence of pain, heat, and tumefaction, the consequences of the diseased action, contracture and rigidity only remaining, he has not necessarily cured, by internal and general therapeutic measures, the morbid constitutional state. This often slumbers after subsidence of the local disease; and he should pause ere he too hastily undertakes the restoration of form and movements by forcible extension under chloroform, or by other active measures, and thus incautiously evokes a renewal of local disorder.

These views were enunciated[1] some years ago by the author, perhaps with more leaning to the employment of forcible extension. It will be found that violent extension is necessary in a relatively small number of cases, provided gentler means are suitably carried out. Orthopædy is capable of curing all those contractions in which the innervation is not hopelessly disturbed (severe paralysis and spasm), and those in which the synovial surfaces, cartilages, and articular extremities of the bones are not disorganized from disease. When we cannot hope to do more than straighten the limb, as in long-standing hip- and knee-contractions from articular diseases, violent extension under chloroform is most opportune as a means of obtaining a more useful position of the member.

The expectations of surgeons some years ago of the benefit likely to result from operative interference in cases of partial hip-ankylosis, so as to produce a new or artificial joint, have not been verified. Excision of the head of the femur, owing to inability to deal effectually with co-existent disease of the acetabulum, has been less successful than elsewhere. In long-standing hip-ankylosis, be it false or true, if we should be unable to straighten the member by gradual mechanical treatment, or by forcible manipulation under chloroform, there is one resource available, that of severing the bone by subcutaneously sawing or drilling it, below the trochanter, where it most nearly approaches the surface.

In a few cases at the other extremity of the pathological scale, in which the will alone, or timidity, or the peculiar abnormal state of the system exists which is met with occasionally in young persons of both sexes, in whom in consequence of slight injury, a limb remains stiff in the straight or bent position (emotional or ideal paralysis), the part is relaxed under chloroformization, and the contracture is often by this means promptly and permanently cured. True hysterical contractures yield with equal facility during the anæsthetic state; but they usually return when the effect of the chloroform has passed off. In some of the severest hysterical cases which the author has met with, recovery has taken place after the lapse of a few months, or a year or two, either spontaneously, or from the effect of altered dietetic, social, or climatic influences.

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[1] Treatise on Deformities of the Human Frame, 1853.

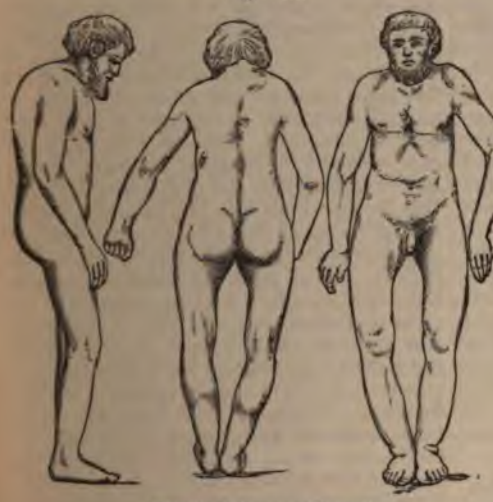
[ADDENDA.

INEQUALITY IN THE LENGTH OF THE LOWER LIMBS.

This has hitherto been regarded as an exceptional deformity. Dr. Hunt[1] called attention to the fact that symmetry is exceptional rather than the reverse. Drs. Cox, Wight, Roberts, and Dwight have made careful measurements of 114 healthy persons and 19 skeletons, and have found that "the greater number of limbs, comparing the limbs of the same person, show a difference in length. About one person in every five has limbs of the same length." The difference is usually from one-eighth of an inch to an inch.[2]

Mr. Callender, after examining 40 persons, found only two with limbs of unequal length;[3] but Dr. Morton (Surgery in the Pennsylvania Hospital) brings additional evidence in favor of the idea that asymmetry is the rule. In 513 boys examined, between the ages of eight and eighteen, the limbs were unequal in length in 272.

Fig. 743.



Osteitis deformans (Bryant).

Osteitis Deformans.

Paget[1] has described an affection which he has termed osteitis deformans, which attacks usually the long bones of the lower extremities and the skull. The bones enlarge and soften; those bearing weight yield. The necks of the femora may become nearly horizontal, but the limbs remain strong enough to support the weight. The disease is attended with pains in the affected bones. Thickening of the bones is found, in the walls of the shaft and in the articular surfaces. The disease begins in middle age or later.[2]

Deformity from Union of Fractures in a Faulty Position.

This subject has receetly been carefully investigated by Dr. Roberts,[3] who advocates refracture at a period after the first injury, much longer than has been previously thought feasible, and reports a successful case of a badly united fracture of the femur operated on six months after the original break.

The most favorable cases are those where the fragments have united at their extremities. If there is lateral apposition, there should be power applied at right angles to the plane formed by the lapped ends. The easiest way is to break with the hands, using a hard surface as a fulcrum. The joints can be protected by bandaging a splint along the limb over each joint. A screw force, as furnished by an osteoclast, can be employed; and it may be necessary to drill the bone to aid in the break. In some cases a powerful extension applied first appears to be of service.[4]

[[1] Am. Journal Med. Sci., January, 1879.]

[[2] Am. Journal Med. Sci., April, 1875; Archives of Clinical Surgery, vol. i., No. 8, Feb. 1877; Philadelphia Med. Times, Aug. 3, 1878; Mass. Med. Society's Communications, 1878, p. 175.]

[[3] St. Bartholomew's Hosp. Reports, vol. xiv., 1878, p. 187.]

[[1] Med. Chir. Trans., 2d series, vol. 42, 1877.]

[[2] Bryant, Guy's Hospital Reports, 1877; also Treves, Brit. Med. Journ., Dec. 18, 1880.]

[[3] Surgery in the Pennsylvania Hospital, 1880.]

[[4] Surgery in the Pennsylvania Hospital, 1880; also Spence's case of refracture, where an osteoclast was used, fracture of the femur 21 mos. old, Edinburgh Med. Journ., xxi., Jan., 1876, p. 769; Le Dentu, Fracture of the leg 3 mos. old, refracture, Gaz. Hebd., July 9, 1880, p. 456.]

AFFECTIONS OF THE MUSCULAR SYSTEM.

By T. Tatum, Esq. (1862), and
J. Lockhart Clarke, Esq., M.D., F.R.S. (1870).

Revised by P. S. Conner, M.D.

Although muscles are so much exposed to accidents and violence, they are not readily injured; nor, considering their high organization, are they frequently the seat of disease. Muscles may suffer from contusions, strains, rupture, and wounds of different kinds. Severe contusions are frequently followed by temporary loss of power in the muscle; this, together with the extreme pain in any attempt to move the part, particularly in the neighborhood of the large joints, sometimes leads to the suspicion of more serious injuries, as fracture or dislocation. Strains of muscles are often followed, especially in later life, by pains of a lasting and troublesome character, partaking of the nature of rheumatism. Muscle may be ruptured either from external violence or from the too energetic action of its own fibres; this latter occurrence is by no means a common one, especially that in which the entire muscle is torn across. In the living body, muscle offers a greater resistance to a force tending to rend it than either tendon or bone; and when it does give way, it is for the most part at its point of junction with the tendon. Sédillot[1] says, that in twenty-eight cases of rupture of muscles, thirteen were ruptured at this point.

The power of resistance in a sound and healthy muscle in a state of full tonicity is enormous; and many interesting comparisons and calculations on this subject will be found in Borelli, De Motu Animalium. Percy[2] relates the case of a person with wry neck, who was suspended by the head, with a view of putting the muscles on the stretch; the result was separation of the muscle from its insertion, but no laceration of its fibres; and in a case in which the thumb was torn off, the tendons were drawn out, but the muscles were left uninjured, except at the point of junction with the tendon. We are all familiar with the fact, that the tendon of the rectus femoris and the tendo Achillis give way rather than the fibres of their respective muscles. With the loss of its vital contractile power, muscle loses its advantage over tendon, and the experiments of Richerand and others fully establish the fact, that after death, muscle is more easily ruptured than tendon. We observe this when a limb is forcibly straightened from the bent position after the muscles have become unusually rigid from convulsions before death; here laceration of the muscles, and not of the tendons, takes place.

Though muscle in the living body is not often ruptured, yet cases of rupture occur sufficiently often to have given most of us one or more opportunities of witnessing it. Sédillot has recorded no less than twenty-eight cases of entire or partial spontaneous rupture of muscles; but he observes, that no voluntary act can occasion a rupture of their fibres, however powerful the effort may be, and this for two reasons: 1st, because, under the influence of the will, all the fibres of a muscle, and the muscles associated with it in its action, contract uniformly, simultaneously, and in a regular order, to overcome a resistance; and 2dly, because at the moment that the will perceives that the power opposed to it is greater than its efforts can overcome, it ceases to strive further. Rupture, therefore, can only take place when, in some involuntary or instinctive effort, as in the endeavor to recover the equilibrium in a false step, or from some similar cause, the whole force is thrown in a violent and unexpected manner upon one or two muscles, or even on a few fibres. [While this is true of healthy muscles it is not so of those which have undergone the vitreous degeneration in consequence of existing acute grave pyrexia. Such muscles may give way either in part or wholly in the effecting of voluntary movements of some slight extent.] Among the cases collected by Sédillot, is one in which the rectus femoris was ruptured. In another case, the psoas magnus muscle was found ruptured after death, the patient having died from inflammation and suppuration following the accident. The complete rupture of the biceps muscle of each thigh occurred in a man falling from a height; and the two recti abdominis were ruptured at their upper part in a young man, in the struggle to save a tray of cement as he was falling from a platform.

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[1] Mém. sur la Rupture musculaire; Mém. et Prix de la Soc. de Méd. de Paris, 1817, p. 115.

[2] Journal général de Médecine, vol. lxi.

It more frequently happens that a few fibres only of a muscle are ruptured, and this usually occurs in the gastrocnemius.[1] Muscles are sometimes torn across in violent paroxysms of muscular spasm, as in tetanus. In these cases the ends of the muscle, from the violence of the retraction, are thrown into considerable swellings.

In a case of acute traumatic tetanus, under Larrey, the man was immersed in cold baths, after each of which the convulsions and muscular contractions were most severe, and he died in three hours; a swelling, however, had been previously observed below the umbilicus, on the right side. On a post-mortem examination, it was found that the tumor was occasioned by the retracted ends of the rectus, which was entirely torn across. The space between the two ends of the muscles was filled with blood.—Mr. Curling describes a case in which portions of both recti abdominis were ruptured by tetanic convulsions (one of the specimens is in the Museum of the College of Surgeons).—Mr. Gray exhibited, at the Pathological Society, the rectus muscle of a patient who had died of tetanus, in whom almost complete transverse laceration of the muscle had taken place.—In Mr. Earle's case of tetanus, described in Med. Chir. Trans., vol. vi., one of the psoas muscles was partially ruptured.—Boyer relates the case of a strong man admitted into La Charité with "bilious fever;" an emetic was given him, and whilst vomiting, acute pain was felt a little below the middle of the left rectus abdominis muscle. On examining the part, there was neither tumefaction nor discoloration of the skin, but an indentation, into which the fingers could be placed, was felt. The man died; and the muscle was found completely torn across, the two ends being an inch apart, and the space between filled with blood.

The rupture of a muscle is accompanied by extreme pain, resembling that occasioned by a smart blow from a whip or stick, and often by a distinct sound like the snapping of a cord; all motion of the part is either impossible, or is accompanied by such severe pain, with spasmodic twitching, as to cause the patient to desist. [Rupture of degenerated muscles may occur without any symptoms manifesting themselves, the accident being unsuspected during life, and its existence revealed only upon post-mortem examination.] If the muscle be a superficial one, a deep indentation will be found at the seat of rupture, produced by the retraction of its divided ends; and often a considerable swelling, proportioned to the vigor of the contraction of the torn fibres, as in tetanus; and as there is always extravasation of blood, much discoloration of the skin will follow. The indentation and extravasation are not apparent, however, in ruptures of the deep muscles, by which their diagnosis is rendered less clear. If the rupture be discovered early, and judiciously treated, a sufficient approximation of the divided ends will result, good union will follow, and the function of the muscle will be restored. If, on the other hand, it be overlooked or maltreated, or if it occur in a part where proper measures cannot be employed to approximate the ends of the muscle, as in some parts of the trunk, in ruptures of the deep muscles about the hip and shoulder, etc., it will be found that a wide separation exists, and that the ends of the muscles instead of uniting, have become attached to the parts in the immediate neighborhood, and the use of the muscle is consequently lost.

The treatment consists, 1st, in placing and retaining the part in a position most favorable for relaxing the muscles; and 2d, in approximating the separated ends to one another by even compression, which we know exercises so great a power in controlling and modifying the excess of contraction in the muscles, in fractures, etc. As regards the first, this is easily accomplished in the limbs: thus in rupture of the rectus femoris the knee is straightened, and the limb is raised to an angle with the body, as in fractured patella; but where the rupture occurs in the trunk, this cannot be done so readily; yet in the case above mentioned, in which both recti abdominis were ruptured, a good union was effected by keeping the patient in a sitting posture, the body being bowed forward, together with proper bandages.[1] The second is accomplished by an even and uniform compression of the muscles by means of carefully-applied flannel bandages, or laced belts, aided in some cases by a strip of leather or gutta-percha. [Better by the application of the plaster-of-Paris or other immovable dressing, or the elastic bandage of Martin.] At the end of from a fortnight to three weeks, the union is generally completed. The process of union is similar to that of other structures; the effused blood is absorbed, plastic lymph is poured out, which assumes by degrees the firm and resisting character of tendon, muscular fibre itself being never reproduced. When a muscle, with the integument and parts around, is divided, it retracts to a greater extent than where the muscle alone gives way, from being deprived of its collateral support. This, in conjunction with an open wound, renders it extremely difficult to approximate the retracted ends of the muscle, and to find means for retaining them in a proper position; hence it will be found that wounds extending through muscles are followed by nearly complete loss of their use, the great chasm between their ends being filled up by granulation. It is recommended to endeavor to bring the ends together by sutures. [The use of sutures has been advised even in cases of subcutaneous rupture.] These, with a position favorable for the approximation of the ends, and such encircling supports as can be employed where a wound is present, may do much towards restoring the muscle to a certain amount of usefulness.

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[1] Wardrop, Med.-Chir. Trans., vol. vii.

[1] Richerand, Nosographie chir., vol. ii.

Inflammation of muscle.—Independently of rheumatism, muscles may be the seat of inflammation from various causes, both simple and specific, which may terminate in abscess, or in some morbid changes of structure, to be described hereafter. Inflammation followed by abscess occurs occasionally in the parietal muscles of the abdomen, arising either from some injury or without apparent cause. It appears first as an extremely painful, and more or less circumscribed swelling, distinctly felt below a portion of the muscular planes: after a time obscure fluctuation is perceived; pain is now very great, especially on the least movement, accompanied by irritative fever. On laying open the abscess, pus, discolored and somewhat offensive, escapes, the symptoms quickly subside, and the cavity readily fills up and heals.

Purulent deposits in the pectoral muscles, extending to the intercostal muscles and diaphragm, occurred in a case described by Mr. Hacon in Path. Trans., vol. v., p. 329. The patient had rigors and other symptoms of fever ten days before his death, with great pain in the right hypochondriac region; formation of matter was suspected, and pus followed the introduction of a needle. There were no purulent deposits in any viscus.

Secondary deposit of pus sometimes takes place in muscles as well as in other structures. A case is given of phlebitic suppuration in muscle, originating in what he terms puerperal rheumatism, by M. Cruveilhier.[1]

Inflammation may occur in muscles as a symptom of secondary, or rather tertiary, syphilis. In a paper read before the Royal Medical and Chirurgical Society in January, 1845,[2] Mr. Tatum describes a group of three cases, two of which were associated with other symptoms of constitutional syphilis, whilst the history of the third case was obscure. The disease, which he had not seen described before, appeared in the form of rounded enlargements in the left sterno-cleido-mastoid muscle; there were three swellings in two of the cases, and two only in the other; in one of these there was also an enlargement in the tendinous origin of the muscle; the tumors were evidently formed in the substance of the muscles, and were nearly of the size of a pigeon's egg, and gave a singular beaded appearance to the muscles; there was stiffness, with much tenderness, in the part, and great pain when the muscle was in action; the skin was neither adherent nor discolored; the disease was slow in its progress, and had remained nearly stationary for some months. All the cases occurred in females, probably from the neck being more exposed than in men; in each case the effects of the iodide of potassium were manifest. In the first case the patient obstinately refused to take the iodide of potassium, in consequence of which mercury and various other remedies were tried without any good effect. After some time she consented to take the iodide of potassium; from two to three grains were administered thrice daily, and the iodine ointment was applied externally; the tumors soon began to diminish, and in less than six weeks completely disappeared. The other two cases were similarly treated with complete success; but in one of them the patient was obliged to lay aside the remedy for a time, during which it was remarked that the tumors became stationary; on her resuming the medicine, however, all remains of the disease quickly left her. What constituted the swellings could not of course be ascertained from these cases; but a case occurred some time after, in which there was a tumor in the middle of the biceps muscle, so hard and defined as to induce the surgeon to proceed to its removal by operation, when, on cutting into the fibres of the muscle, no tumor was visible, but the muscle in that part was congested and infiltrated with a grayish kind of lymph, great part of which oozed away with much blood, all the swelling subsided, and the wound healed, leaving no enlargement. Much light has been thrown upon the nature of these affections of the muscles and the changes they undergo by M. F. Bouisson, of Montpelier, under the title of *Tumeurs syphilitiques des Muscles.*[1] According to him, both tendons and muscles are the seats of syphilitic tumors and contractions, which occur in conjunction with other symptoms of constitutional syphilis. He has observed these tumors in the gluteus maximus, the vasti, trapezius, the sterno-cleido-mastoid; also in the muscular structure of the tongue, lips, and pharynx. With regard to the treatment, he for the most part found the iodide of potassium, given internally, with the external use of the iodine ointment, very effectual in removing the tumors, except those of the tongue and pharynx, which were very obstinate; in these cases the muriate of gold, in doses of from $\frac{1}{16}$th to $\frac{1}{8}$th of a grain, was given with success. M. Bouisson was fortunate in having opportunities of seeing this disease in its advanced stages, as well as the stage above described. He found the enlargement continue with little change, except under the treatment of the iodide of potassium, etc., for a considerable period. Sections of the tumors presented an infiltration and deposit between the fibres of a gray plastic exudation; many of the muscular fibres were nearly colorless. This state may be followed either by a softening of the effused matter and its conversion into a kind of mucilaginous fluid, or may form an abscess, which, on slowly getting to a head, may burst, and leave an unhealthy ulcer with sloughy surface and foul discharge. Some of these enlargements, instead of suppurating, harden and become converted into cartilaginous or even bony structure.

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[1] Path. du Corps humain, fasc. 17.

[2] Lancet, Feb. 1, 1845, p. 136.

[1] Gazette médicale de Paris, July, 1856.

A case is described in the Gazette des Hôpitaux, January 16, 1858, of a tumor involving nearly the whole length of the sterno-cleido-mastoid muscle. When the muscle was contracted, the swelling was immovable, but in the relaxed state it could be moved on the deep plane of fibres; the skin, though not adherent, did not slide readily over it as natural, and there was a slight blush on it; there were dull pains in the part, which occurred at uncertain intervals, not more by night than by day; neither respiration nor deglutition was impeded. There were decided traces of old constitutional syphilis, as in most of the cases reported. The patient was about to undergo a course of the iodide of potassium.

Sometimes these swellings assume the form still more completely of defined tumors.

M. Robert[1] describes a case of a tumor which formed in the calf of the right leg, as large as an egg, hard, unequal, and lobulated on the surface, somewhat movable, tender to the touch, but not painful, which was completely cured by the iodide of potassium.—In Path. Trans., vol. vii., a very interesting account of a tumor is given by Mr. S. Jones; the tumor was removed by Mr. South from a patient in St. Thomas's Hospital, November 6, 1855. The patient had had syphilis eight years before, when he took mercury, but had no constitutional symptoms. He had received a blow on the left shoulder two years previously, and lost for some time the use of the arm; he, however, gradually recovered it after some months. He had pains in the shoulder, which were considered rheumatic, and were treated and cured by the iodide of potassium; nodes also presented themselves at several points, but they disappeared. Violent pains again came on in the shoulder, which were followed by a tumor in the infraspinal region of the scapula; this increased rapidly in size; his general health suffered considerably. The tumor was well defined, moved only with the scapula, did not project much above the surface, and measured 6$\frac{1}{2}$ inches in one direction, and 8 in another; it was removed with a large portion of the scapula. On examining it, it was found to be formed in the muscles, but principally in the infraspinatus, though nodules were found in many of the neighboring muscles. The tumor was mostly hard and dense, slightly elastic, of a dead-white color, and of a homogeneous or slightly reticulated structure; the surrounding muscular fibres were directly continuous with its surface, and muscular fibres were present in great abundance in many parts of the tumor. Many of the fibres, examined by the microscope, had lost their striated character, and had become glistening, transparent, and structureless. The spaces between the fibres were occupied almost solely by cells. Mr. South has since informed me that the wound healed well, and there has been no sign of returning disease.

Simple contraction, or shortening of a muscle without apparent alteration in its structure or change from its normal condition, seems to be an occasional effect of the inflammation from syphilitic poison in the system, and is usually found in the muscles of the arm or forearm. M. Ricord has noticed this so long ago as 1842.[1]

M. Notta, in an interesting paper on Syphilitic Muscular Contractions,[2] gives three cases, the features of which were much the same; and in each the biceps was the seat of the contraction. There was no hardness or rigidity of the muscle when not in action; the pains were variable, being great on putting the muscle on the stretch, and mostly referred to its insertion. The contraction was slow, and gradually reached a certain point, causing fixed flexion of the elbow. The iodide of potassium, with minute doses of the proto-iodide, appears to have cured every case. The same may be said of the cases cited by Ricord[3] and others, in which there was a certain change of structure of the muscle, associated with contraction. As a general rule, mercury has done no good; in fact in

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[[1] L'Union Médicale, No. 37, mars 29, 1839.

[1] Gaz. des Hôpitaux, p. 98.

[2] Archives générales de Médecine, sér. 4, vol. xxiv., p. 413.

[3] Gaz. des Hôpitaux, 1846, p. 1.

many of the cases the disease appeared to increase while the patient was undergoing a course of mercury.

[The syphilitic affections of muscles present themselves under three forms, functional, inflammatory, and myomatous. In the first, which is characteristic of the earlier periods of the disease, there is complaint of pains located in the fleshy part of the muscle or muscles; weakness, sometimes of extreme degree; fibrillary tremblings; and unsteadiness of action. In addition to these symptoms which, more or less well marked, are met with in almost all, if not all cases, there is occasionally observed an insidiously commencing and ordinarily slowly advancing contraction of certain of the muscles of the extremities, almost always the biceps flexor of the forearm. This contracture, which perhaps is due to a sub-acute inflammation (Mauriac), differs in all respects except in the produced deformity from the permanent flexure which at times follows specific myositis. There is no observable change other than "shortening of the muscle with tension and rigidity of its tendon," no pain except when an attempt at straightening the forearm is made, nothing but a progressive flexion carried at times up to or beyond a right angle, which flexion cannot be overcome by force. Commencing sometimes within three months, and usually within the first year, it will if left to itself last for an indefinite period, but under appropriate treatment may commonly be made to disappear within a few weeks or at most months.

The inflammatory affections may as a rule be easily differentiated from ordinary myositis, not only by the existing syphilitic history and lesions, but by the less intense character of their symptoms, and in the more severe cases by the peculiar "woody" induration of the affected muscles. The specific exudation, which is poured out both into the interstitial connective tissue and within the sarcolemma, is ordinarily absorbed, and complete resolution takes place; but at times it hardens, and as the result of such sclerosis the muscular elements are destroyed and permanent irremediable contractures result. This fibrous tissue may undergo calcareous or osseous change. The duration of specific myositis may usually be much shortened, and the likelihood of the development of destructive lesions greatly diminished, by proper medication.

Specific myomata, gummy tumors, while often met with, are rare as compared with syphilitic diseases in general. They may or may not be preceded by inflammation, are frequently symmetrical, and are very variable in size. Usually they may be diagnosticated without difficulty, but at times it is almost, or quite impossible to absolutely determine the specific character of a muscle-tumor. By their presence, they as a rule, give rise to some functional disturbance, and when large, may cause pain, swelling, interference with blood-supply, or even inflammation of adjacent parts. Unlike the diffused exudations of myositis, these gummy tumors are likely not to undergo resolution, but to soften and break down and later destroy the overlying tissues, the resulting ulcers being quite intractable. Suppuration of the tumor itself does not take place. Properly treated gummata commonly disappear, but in consequence of the destruction of the involved muscular fibres, functional impairment in many cases remains.]

Muscular atrophy.—Muscular tissue is frequently subject to atrophy, which may consist of one or more of the following alterations:—

1. Simple atrophy.
2. Atrophy with granular degeneration.
3. Atrophy with fatty degeneration.
4. Atrophy with (the so-called) waxy degeneration.

In *simple* atrophy the degree of wasting of the muscular tissue varies considerably. Generally, the fibres, although paler and reduced in diameter, retain their anatomical characters. The transverse and longitudinal striæ are well marked, the sarcolemma preserves its usual delicate and transparent appearance, and the nuclei it contains are not increased in number. Such is the form of atrophy met with in chronic and exhausting diseases; in cerebral paralysis; after contusions, compressions, and affections of the joints. In many diseases, however, both acute and chronic, simple atrophy, or wasting of the muscular fibres, is accompanied, in a greater or less degree, by one or more of the degenerations above mentioned. Such is sometimes the case after acute fevers, particularly typhus or typhoid; after alcoholism, lead poisoning, rheumatism, etc. But there is another form of this malady, which is known by the name of *progressive muscular atrophy* (Cruveilhier), *atrophie musculaire graisseuse progressive* (Duchenne), and *wasting palsy*. This curious disease differs in several respects from the atrophies above mentioned. It is always chronic, but of uncertain duration; is frequently hereditary; is capricious or irregular in its invasion; prone to spread from one part to another, or become general, and thus go on to a fatal termination. The affected muscles suffer different degrees of wasting, and assume a variety of aspects. Even in the same muscle, bundles in different stages of atrophy and degeneration may be found at the side of others that have retained their normal state. When the wasting is extreme in all the bundles, a long muscle may be reduced to a mere fibrous and cylindrical cord, or to a kind of tendon, and a flat muscle may be reduced in the same manner to a kind of membrane. In some instances the atrophy may be *simple*, that is, the muscular tissue may be wasted to a considerable degree without any granular or fatty degeneration;[1] but generally, one or both of these alterations of structure is found to exist to a greater or less extent. The muscle also changes and varies in color according to the nature and degree of the atrophy. It is paler than natural; occasionally it is quite colorless, like the flesh of fish; or it may have a faint yellow or ochreous tint. Its consistence for the most part is increased in consequence of the increase of the interfibrillar connective tissue. When examined under the microscope, the affected muscles may be seen to have lost to a variable extent and degree, or even entirely, the appearance of transverse and longitudinal striation, while in a corresponding proportion the sarcous or muscular element is transformed into granules, which, in some instances, are too fine to be distinguished as separate particles. The granules are soluble in acetic acid.

Granular degeneration or disintegration of the muscular tissue may exist alone; but frequently it is accompanied by fatty degeneration, or may only form the first stage of the latter change.

Fatty degeneration.—This morbid process may make its appearance in the muscular tissue at once; or may follow, accompany, and altogether replace the granular change. Besides this transformation into fatty *particles*, fat-cells in unusual, and sometimes in great numbers, are found between the fibres, either collected into groups, or disposed in linear succession, like rows of pearls. These cells may multiply in proportion as the muscular tissue disappears, so that, when the fibres are reduced to mere filaments, there may be no loss of volume in the limb. An interesting case of this description is related by Mr. Hallett.[2] The degenerations seemed constantly to have commenced on the surface of the muscles, and extended inwards to their centres; so that many which appeared wholly converted into fat, exhibited, in their interior, muscular fibres in a more or less healthy condition.

Waxy or vitreous degeneration.—This structural change was first described by Zenker.[1] It is called by the French pathologists, *vitreous* degeneration.[2] According to Zenker, it is observable only in the voluntary muscles, and never attacks all the bundles of the same muscle. The essential change of structure consists of a transformation of the muscular tissue into a homogeneous, colorless, and glistening substance, in which the transverse and longitudinal striæ, together with the nuclei, have entirely disappeared. This kind of degeneration is more common after acute diseases, particularly after typhus and typhoid fevers, but occurs also in *progressive muscular atrophy*. Indeed, in this peculiar malady, all the three kinds of degeneration—the *granular*, the *fatty*, and the *vitreous*—may be seen, not only in the same patient, but in the same muscle.[3]

In a large majority of instances, *progressive muscular atrophy* first makes its appearance in one of the upper extremities, especially in the right limb. It begins commonly in the muscles of the hand, first in the thenar eminence, then in the hypothenar, and next in the interossei. [By many the first external interosseous muscle is declared to be the one primarily affected.] When the interosseous muscles are considerably wasted, the hand assumes the appearance of a bird's claw—the *main en griffe*, as it has been termed by Duchenne. If the atrophy extends upwards, the flexors and extensors of the fingers, and sometimes the muscles at the back of the forearm, become involved. When the disease extends beyond these limits, it attacks the muscles of the arms and trunk; the biceps first, then the deltoid and the triceps, the pectorals, the latissimi dorsi, the rhomboidei, the extensors and flexors of the head, the sacrolumbales, the abdominal muscles, the muscles of respiration and deglutition. Occasionally the depressor muscles of the jaw become involved. In some instances the atrophy is limited to the muscles of the forearm, and in others it begins in the muscles about the thorax, and makes considerable progress, while the arms remain unaffected. Sometimes it extends to the lower extremities, but rarely begins there.

The unequal and irregular wasting of the muscles produces in the trunk and limbs a variety of alterations in their shape and position, which are characteristic of the disease; for in ordinary atrophy succeeding exhausting diseases, the emaciation is uniform, as it affects nearly all the muscles of the part to the same extent.

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[1] Charcot, Hayem, Lockhart Clarke.

[2] Edinb. Med. and Surg. Journal, April, 1849.

[1] Ueber die Veränderungen der willkürlichen Muskeln in Typhus abdominalis, Leipzig, 4to., 1864.

[2] Cornil et Ranvier, Histologie pathologique.

[3] Charcot et Jouffroy, Archives de Physiologie normale et pathologique, 1869, No. 3, p. 363.

The earliest symptom of progressive muscular atrophy is a loss of muscular power in the afflicted parts, especially after exercise or exposure to cold. With this weakness there is an awkwardness in the patient's movements, and a certain loss of muscular co-ordination, arising from the unequal or irregular wasting of the muscles, and the consequent change in their relative force or antagonism when employed in the performance of voluntary movements. Among the other early symptoms are cramps, twitches, and fibrillary tremors in the muscles. Generally the sensibility remains unimpaired, but occasionally there is numbness of the skin, or a certain degree of cutaneous anæsthesia; while, on the other hand, in about half the cases, more or less pain is experienced in the wasting muscles, or previous to their atrophy.

Pathology.—Cruveilhier, who was the first to investigate the morbid anatomy of progressive muscular atrophy, believed that atrophy of the motor nerves was the starting-point of the disease. This opinion was founded on eleven cases in which the motor nerve-roots were more or less wasted. But in the majority of instances in which post-mortem examinations were made, no appreciable alteration of the nerve-roots was discovered. It was therefore inferred that atrophy of the nerves cannot be the actual cause of that state of the muscles; and since no disease of the nervous centres had hitherto been detected, it was further inferred and generally believed that progressive muscular atrophy is a disease originating in the muscles themselves, in consequence of impaired nutrition, resulting from a peculiar diathesis or an hereditary tendency. The more recent supporters of this view were Trousseau, Duchenne, Meryon, Roberts, Oppenheimer, Friedberg, Hasse, Friedreich, Cohn, and others. But in 1861, I discovered in the spinal cord removed from a well-marked case of progressive muscular atrophy, numerous lesions of the gray substance, consisting chiefly of areas of what I call granular and fluid disintegration.[1] In several other cases which I subsequently examined, the same kind of lesions were observed in company with similar alterations of some of the white columns, with dilatation of bloodvessels, or atrophy of the nerve-cells and of the anterior roots of the nerves.[1] Since my first publication on this subject, several German and French pathologists, by means of improved methods of observation, have obtained similar results.[2]

Etiology.—Among the predisposing causes of progressive muscular atrophy, consanguinity, or hereditary influence, is universally acknowledged to hold the first rank. Dr. Roberts collected the history of ten families in which muscular atrophy prevailed, and of these, twenty-nine individuals were attacked. Aran relates that a sea-captain had lost two maternal uncles and a sister by this disease, and that another patient's two aunts had died from the same malady. Meryon's first cases were four boys who had six healthy sisters.[3] In another family two boys were affected, while the two sisters escaped. The male sex is therefore much more prone to muscular atrophy than the female—in the proportion of about six to one. In nearly all the hereditary cases on record, the disease became generalized, and therefore tended to a fatal termination.

Among the chief exciting causes are excessive muscular exertion, cold and damp—especially when combined—and injuries or diseases of the spine. In those cases which are attributable to the influence of cold and wet, the atrophy is generally preceded and accompanied by neuralgia or so-called rheumatic pains in the affected muscles, or in the course of the nerves leading to them. Syphilis, again, appears to be one of the assignable causes of the disease. To this form M. Rodet has given the name of *atrophie musculaire progressive syphilitique.*[4] In some instances no particular cause can be clearly assigned, and these are the cases in which hereditary influence appears to come into operation.

Treatment.—This must of course depend, to a certain extent, on the causes to which the disorder may be reasonably traced. Removal from the influence of cold and damp, or avoidance of undue muscular exertion, is of primary importance. Warm and sulphur baths, especially those of Aix-la-Chapelle, have been particularly recommended. When there appears good ground for believing that the atrophy is attributable to syphilitic taint, iodide of potassium, or perhaps mercury, must be employed. In cases attributable to other causes, vegetable and mineral tonics, cod-liver oil, and phosphorus may be administered. Dr. Meryon speaks very highly of the long-continued use of arsenic. But of all remedies hitherto employed, galvanism is undoubtedly the most useful, when applied to the affected muscles. The benefit derived from it, however, is very often temporary. Remak strongly recommends the application of the constant galvanic current to the spinal column, particularly in the cervical region. The fact, as already stated, that in the advanced stages of progressive muscular atrophy, various lesions have been found in the spinal cord, would suggest the propriety of trying the effects of counter-irritants, particularly setons and blisters to the spine, in the early stages of the disease.

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[1] Beale's Archives of Medicine, 1861.

[1] British and Foreign Med.-Chir. Rev., July, 1862, and Oct., 1863. Beale's Arch. Med., No. 13; Med.-Chir. Trans., 1866 and 1867.

[2] See especially Hayem, Archives de Physiol. normale et Pathologique, Nos. 2 and 3, 1869. Charcot et Jouffroy, Ibid., 1869.

[3] These interesting cases, with the microscopic appearances of the muscles, are recorded in vol. xxxvi. of the Med.-Chir. Trans.

[4] L'Union médicale, No. 26, p. 403, 1859.

There are two other special forms of muscular atrophy, which are peculiar to the period of childhood, viz., the atrophy which follows infantile paralysis, and the degeneration of muscles with apparent hypertrophy.

1. The muscular atrophy of infantile paralysis is extremely interesting to the surgeon, in consequence of the deformities which it so frequently occasions. The period of childhood at which this disease makes its appearance varies from a few months to a few years after birth, more especially during the first dentition. The attack is generally sudden, and frequently preceded by a feverish state which may last a few hours or a few days, accompanied occasionally by convulsions, which are immediately followed by paralysis without loss of sensibility. The paralysis generally begins in the lower extremities, but rarely attacks the upper extremities alone. At first it is more or less general, but after a variable period it restricts itself to particular muscles, or groups of muscles, or to a particular member, and thus becomes localized. The muscles upon which it most frequently fixes are those at the anterior part of the leg—the extensors of the toes, and flexors of the foot; the extensors and supinators of the hand; the extensors of the leg, and muscles of the foot. Sometimes single muscles are affected, and most commonly, the extensor longus digitorum of the foot, the tibialis anticus, the deltoid, or the sterno-mastoid. After a time, varying generally from one to two months, but sometimes much longer, the paralyzed muscles begin to waste, and may ultimately be reduced to mere fibrous bands. Nor is the atrophy confined to the muscles; it involves the bones, ligaments, and other parts.[1]

The paralysis and the atrophies by which it is succeeded combine to produce a variety of deformities and unnatural attitudes which call for the surgeon's skill, either in the application of mechanical apparatus, or in the performance of necessary operations. These deformities consist chiefly of *talipes equinus*, *equino-varus*, *equino-valgus*, *calcaneus*, or *calcaneo-valgus*, and *talipes varus*.[2]

The paralysis itself and the muscular atrophy to which it gives rise are not often fatal. The difficulty consists in restoring the muscles to their normal condition: but this, in many instances, may be accomplished. The remedies recommended by the most experienced practitioners consist of nux vomica, strychnine, cod-liver oil, the preparations of bark and iron; sulphur and salt-water baths; blisters and counter-irritants along the spine; stimulating embrocations to the affected muscles, and especially the application of electricity.

2. *Degeneration of muscles with apparent hypertrophy.*—This peculiar disease was first understood and diagnosed by Dr. Duchenne (of Boulogne) in 1858. Since then it has been recognized and investigated chiefly in Germany by Griesinger, Eulenburg, Cohnheim, Berind, Wernich, Oppolzer, Heller, and Seidel. It begins in childhood, like the malady just described, but often continues up to an advanced period of youth, when the patient is cut off by some intercurrent disease. Its course may be divided into three stages: a stage of partial and incomplete paralysis; a stage of apparent muscular hypertrophy, and a stage in which the paralysis becomes general, and the muscles waste.

The first stage begins with weakness of the lower extremities either before or after the period at which the child should be able to walk. In the former case, when the little patient attains the age of ten or twelve months, and attempts to walk or stand, it falls immediately, and continues unable to walk, even when assisted, for two or three years.

The second stage begins some months—or even as long as two years—after the muscular weakness, and is manifested by a progressive enlargement of the gastrocnemii, then of the glutei and lumbar muscles. This enlargement occurs sometimes in nearly all the muscles, but in general it is limited to a few. The enlarged muscles are firm and elastic, and become very strong during contraction. This condition may remain stationary for some years.

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[1] Laborde relates a case in which considerable atrophy of the deltoid muscle occurred in four days after the first appearance of the paralysis. De la Paralysie (dite essentielle) de l'enfance, p. 45.

[2] For the description and treatment of these deformities, see the previous article, ORTHOPÆDIC SURGERY.

In the third stage the paralysis gradually increases and becomes more general. The patient is no longer able to stand upright; the upper extremities become affected; the enlarged muscles rapidly decrease in volume; and the limbs and trunk become atrophied *en masse*. In this state the patient may exist for a considerable time, but ultimately dies by intercurrent disease. Many of the children afflicted with this singular disorder have dull intellects, and are occasionally more or less idiotic.

Morbid anatomy.—The morbid anatomy of this disease has been investigated chiefly by Duchenne, in France, and by Eulenburg, Cohnheim, Griesinger, and others in Germany. Nothing abnormal could be discovered in either the nervous or vascular systems. Eulenburg and Cohnheim found the electro-muscular contractility everywhere perfect. To the touch the muscles gave the sensation of a doughy and inelastic mass. They were marked with stripes of a yellow or yellowish-white appearance. At certain points they could not be distinguished by the naked eye from the subcutaneous adipose tissue. There was also great hypertrophy of connective tissue between the muscular fibres, which were frequently much reduced in diameter, although they were not otherwise much altered. Duchenne and Ordoñez found the striæ on the fibres very much finer than usual, and semi-transparent. The same appearance, together with an increase of connective tissue, and large collections of fat-cells, were also observed in one case by myself.[1]

Treatment.—During its first stage the disease is sometimes curable. Duchenne has recorded two such cases.[1] But in the second stage scarcely any hopes of recovery can be entertained. The treatment consists chiefly of local faradization and shampooing.

Ossification of muscle.—The conversion of muscle into fat is truly a degeneration, as it is a change from a highly organized structure into an amorphous mass of adipocere. The same may be said of the so-called bony deposits in many soft parts, which are not true bone either in their structure or their chemical composition; while the ossific growth in muscle possesses all the qualities of true bone, and is merely the development of one organic structure within another, to which the term "degeneration" would ill apply. Mr. Hawkins, in a clinical lecture to which I shall have again to refer, remarks that the ossific deposit in muscle is that of true bone with cancelli, compact shell, periosteum, and cartilage, displaying also under the microscope all the signs of true bone. Mr. Quekett showed Mr. Tatum some beautiful microscopical preparations, which prove the true bony nature of these deposits. Ossific growths may take place over a large extent of the voluntary muscles, or may be limited to one or two points. In the Museum of the College of Surgeons is the skeleton of a man in whom nearly all the muscles of the back had become ossified, large sheets and masses of bone occupying the places of the latissimus dorsi, spinalis, and rhomboid muscles, forming large bony sheets on the back and sides, while large stalactic growths of bone spring from the pelvis, ribs, and scapulæ. The following case is valuable from the circumstance of its progress having been watched from its commencement up to its very advanced state in 1862, when the account was published.

G. Brown, aged twenty-two. was originally admitted into St. George's Hospital under the care of Mr. Cæsar Hawkins in August, 1843,[2] with swellings in the dorsal and lumbar regions, some of them apparently bony. Their appearance was accompanied with severe rheumatic pains. All these disappeared under treatment. They reappeared, however, and then one was removed from between the trapezius and rhomboid muscles; it was intimately connected to both, fibres from both being inserted into it; one end of it was fixed to the spines of the sixth and seventh dorsal vertebræ, the other was smooth, playing on the end of the scapula. After this, for four years, fresh tumors were observed to form in different muscles of the trunk and neck, being at first soft, growing rapidly, then becoming hard, and, after a time, either disappearing altogether under treatment, or leaving a bony deposit behind. This new bone extended slowly towards either extremity of the muscle in ridges corresponding to its fibres. He was now lost sight of, but in June, 1859, again presented himself at St. George's Hospital, with extensive ossification of the muscles, together with several exostoses both on the spine and ribs. The greater part of the latissimus dorsi on either side, especially at the free edges, was ossified; large masses of bone filled up the hollows on either side of the vertebral spines from the sacrum to the occiput, soldering all the bones together into an inflexible column. The ribs were likewise immovable, partly from being ankylosed to the spine, and partly by the ossification of the muscles connecting them with the scapula and spine; so that respiration was entirely performed by the diaphragm. The trapezius, and, apparently, the deep muscles at the sides of the neck, contained large deposits of bone; both scapulæ were immovably fixed to the ribs, principally by the ossification of the serratus magnus and rhomboid muscles. In front, both the great pectoral muscles, from their origins to their insertions, were almost entirely ossified, presenting ridges taking the course of the fibres, and forming large masses at the folds of the axilla. The sterno-hyoid and sterno-thyroid muscles were much ossified; and these, together with the recent appearance of a considerable swelling below the chin, had been accompanied with so much difficulty in deglutition as to alarm him; he therefore came to the hospital to see Mr. Cæsar Hawkins, under whose care he had before been. The fulness in the upper part of the throat was not hard, but very tender; it yielded to a second application of a blister in a few weeks, so that the genio- and mylo-hyoid muscles could be distinctly felt almost entirely ossified. Preparations from this case are in the Museum of St. George's Hospital.

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[1] Dr. Duchenne has invented an ingenious instrument which he calls the "emporte-pièce histologique," for removing small portions of muscle from the living subject. It is made by Charrière, of Paris, and consists of a steel cylindrical rod, divisible longitudinally into two parts; one of these is fixed to a handle by means of a screw, and terminates at the screw end in a small hollow cone, the base or lower border of which has a sharply-cutting edge. When closed, the two pieces together form a small cylindrical rod with a fine point. As soon as it is made in this state to penetrate the muscle, the hollow cone is opened by sliding down the other half of the rod, and incloses a small portion of the muscle, which it cuts and brings away as the instrument is withdrawn.

[1] De la Paralysie musculaire pseudo-hypertrophique, Paris, 1868; and Archives gén. de Méd., Janvier et seq., 1868.

[2] Med. Gaz., vol. xxxiv., 1844, p. 273.

The cause of osseous growth in muscles is not easily explained. A tendency to increased bony deposit is not very uncommon, and shows itself in exostosis and extension of bony growth into the tendons inserted into the bones; but in ossific growth in muscle it is a distinct formation, and in no way, at first, connected with exostosis. It is of inflammatory origin, as the pain and swelling, and also the effects of remedies, would indicate. Mr. Abernethy mentions the case[1] of a lad in whom either an exostosis or bony growth in a muscle invariably followed a blow on the part. Mr. Hawkins alludes to an account of eighteen cases of bony growths in muscles among the recruits in the Prussian service; these were said to have been the result of inflammation in the deltoid and pectoral muscles. Inflammation of muscle is rare, and excess of bony deposit in the system is not very common; but when they both occur in the same individual, the exudative lymph in the former would seem to be a favorable nidus for ossific deposit. As regards the treatment, no local measures answered in the above case so well as blisters, under which, with the exhibition of colchicum internally, considerable diminution of the swellings and relief of the pain took place. The swellings completely disappeared after a course of the iodide of potassium, at first five, and then seven grains thrice a day in sarsaparilla; but they returned again shortly after, while the patient was still taking the medicine. On the reappearance of the disease, mercury was given, two grains of calomel and a quarter of a grain of opium twice daily, which at the end of three weeks produced sore mouth; again, all the swellings were nearly removed, at first rapidly, then slowly; but a large mass of bone between the scapula and spine was removed, as stated, by operation. After this, from hemorrhage and other causes, his health failed, and he was much reduced, and specifics were laid aside for some time. Numerous fresh tumors having, however, formed, he, in a few months, began the phosphoric acid, first in half-drachm, and afterwards in drachm doses, three times daily, which he continued from April 6 to May 21. The swelling greatly diminished under this treatment, and with the repeated application of blisters their recurrence seems to have been arrested. Thus the remedies appear to have been chosen with a view to the inflammatory nature of the complaint, and to have been most efficacious; yet so strong was the tendency to relapse, that the swellings formed again and again, even under the treatment that had caused them to disappear. They were, however, finally arrested, the blisters having been most conducive to that end.

[Two very different forms of true muscle-ossification occur, the one limited, not at all infrequently met with; the other general, and of great rarity. In the former, of which examples are found in the so-called "exercise-bones," moderate inflammation of the connective tissue, consequent upon slight but frequent repeated irritations, is followed by an osseous transformation, with associated destruction of the sarcous elements from pressure and diminished blood-supply, and much more rarely the deposition in them of lime-salts. In the general form, progressive myositis ossificans, of which the cited case of Mr. Hawkins was an example, a very different state of things exists. Commencing in childhood, or even in infancy, as a hyperplastic inflammation of the connective tissue, atrophy soon follows, and bony transformation succeeds. The muscles of the back or neck are primarily affected, but in time all the muscles of the body, except those which are essential to respiration, nutrition, and reproduction will be involved in the bony change, unless the subject of the disease should die of some intercurrent affection, or from exhaustion, local gangrene, etc. The exciting cause of this necessarily fatal form of myositis is as yet undetermined, but the phenomena which it presents in its course are certainly very like those of amyotrophies of nerve-origin.]

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[1] Surg. Lectures, vol. iii., p. 169.

TUMORS IN MUSCLES.

Tumors of different kinds are occasionally found in muscle. Perhaps that which occurs most frequently is the fibrous tumor, of a cartilaginous hardness, and often growing to a considerable size.

A lad, aged fourteen, was under Mr. Tatum's care in St. George's Hospital in the summer of 1860, with a tumor as large as the double fist, at the back part of the left thigh, about its middle; it was extremely hard, and appeared to be a chondroid tumor growing from the bone, so closely did it seem to be attached to it; on relaxing the muscles, however, by bending the knee, it admitted of a certain movement on the femur. The tumor was removed, but not without difficulty, partly from its vicinity to the bone, which it seemed to grasp, and partly that the great sciatic nerve was imbedded in it, and was only freed by careful dissection. The tumor was found to have its origin in the semi-membranous muscle, the lower part of which was healthy, but the part above the tumor was converted into a pale structure similar to the tumor, but less dense, and retaining the form of the muscle, with a slight remnant of fibrous appearance. The tumor was extremely dense, of a semi-transparent, cartilaginous aspect. Some of the fibres of the muscles were spread over the tumor; others dipped into it, but were soon lost in its substance.

Shortly after this, a tumor of a similar character was removed from the deltoid muscle of a young man by Mr. Johnson; it was about the size of an egg, and surrounded on all sides by muscular fibres. Many of the fibres entered and could be traced a considerable way into the dense fibro-cartilaginous mass.[1]

The recurring fibroid, although it does not originate in muscular structure, has a great tendency to be reproduced in it. [Sarcomata, though generally originating outside, are at times primary affections of muscles.]

In two patients under the care of Mr. Hawkins in St. George's Hospital, each of whom had a tumour of this description in the breast, and in whom the tumors returned, and were removed several times, it was observed that when the recurrence took place the pectoralis major was the part principally involved. A man came under Mr. Tatum's care, from whom a tumor of the above nature had been removed from the parotid region, and subsequently a recurring small one from over the masseter muscle; four months after which he became Mr. Tatum's patient, having a tumor about the size of a French walnut in the neighborhood of the second cicatrix. On removing it, Mr. Tatum found that it had formed in the upper part of the masseter muscle, a few fibres of which only remained. A few months after this, he again came under Mr. Tatum's care, with two tumors the size of filberts a little above the site of the last, and which proved, on dissecting them out, to have had their seat in the temporal muscle. Mr. Tatum had a lady under his care from whose breast he twice removed a tumor of the above nature; the disease returned in the pectoral muscle, in which it made rapid progress. The event of this case is not recorded.

Cysts of various kinds are occasionally found in muscles. Some of these cysts contain hydatids. Such is the *trichina* spiralis, a bisexual and minute nematode worm which is reproduced viviparously by the female parent. The female trichina is about one-third longer than the male, and in the mature state contains in its uterus a variable number of ova, as well as free embryos in different stages of development. When the flesh of an animal containing spiral trichinæ is eaten by another, the contents of the small intestines are found, after about twenty-four hours, to contain a multitude of these worms, which lie imbedded in the mucus or in the chyme. Soon after the embryos are born, they begin to migrate from the intestines in search of muscular tissue, upon which they feed and develop. Concerning the manner in which migration is effected, there is some difference of opinion. Most observers believe that the young trichinæ pierce the walls of the intestines and other parts until they reach the muscles; while other observers, with Dr. Thudichum, contend that, after penetrating the mucous membrane of the intestines, they enter the bloodvessels and lymphatics, pierce the lymphatic glands, reach the heart with the venous blood, traverse the lungs, and are then distributed, by the arterial circulation, to all parts of the body. However, having reached the muscles, there they feed, and grow, and ultimately become encapsuled. Leuckart maintains that the young trichina always penetrates the sarcolemma, while other observers asserts that it lives and grows either inside or outside that sheath. However this may be, so long as the worm remains outside, the muscular fibre is not permanently damaged, although it becomes somewhat granular, and loses the distinctness of its transverse striation. But if the parasite pierces the sarcolemma, the fibre is permanently destroyed; the sarcous elements are disarranged, broken up, and transformed into granular masses, which constitute the food of the invader. As the trichina reaches its full growth and becomes fixed to one spot, the interstitial connective tissue and the sarcolemma around it, being irritated and inflamed, throw out an exudation, while the nuclei of both enlarge, divide, and rapidly multiply. The exudation, which appears to consist of fluid fibrin, soon after solidifies and forms a capsule in which the worm coils itself up. At the end of some weeks after infection, fine dark granules of carbonate of lime and magnesia are deposited in variable numbers within the capsule, and render it more or less opaque.

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[1] Mr. Curling gives an account of a fibrous tumor which he removed from the gastrocnemius muscle of a girl aged nine; its circumference was not very clearly defined from the muscle, so that its more prominent central part only was removed. See Path. Trans., vol. vi., p. 346. Mr. Birkett removed a tumor from the short head of the biceps flexor cruris, of a chondro-osteoid growth, 4½ by 3 inches in size, of a grayish-pearl tint, and of cartilaginous structure; the centre was of bone. Ibid., vol. ix., p. 397.

In man, trichinosis is produced by the ingestion of imperfectly-cooked flesh of animals infested with trichinæ—particularly pigs.

The pathognomonic symptoms of trichinosis are the following:—

Sudden swelling of the face, particularly the eyelids, after the patient has for some days felt prostrate and lost his appetite; fever, with quick pulse and copious perspirations, which have sometimes an offensive odor; painfulness and immobility of arms and legs; the muscles are swollen and contracted, and give great pain when set in motion or touched; the limbs are semiflexed; gastro-intestinal catarrh, with red and somewhat dry tongue; when the swelling of the face has subsided, the feet, legs, and thighs become œdematous, and soon after anasarca over the trunk ensues. There is no other disease in which this particular combination of symptoms occurs.[1]

Cysts containing a black tenacious matter are occasionally found in muscles; they probably are of the nature of hematoma occurring in other parts of the body, being merely unabsorbed extravasated blood, which has become darkened and inspissated by time. Warren describes a singular tumor somewhat of this nature. A tumor about the size of an egg was removed from the substance of the rectus femoris muscle of a woman; it was said to be of only five or six months' growth; it consisted of a hard dark-colored muscular substance, in the centre of which was a bony shell an inch in diameter, containing a dark-colored fluid, which had deposited a black crust on the bony cyst.

Vascular tumors are not very frequently found in the substance of muscles. According to Mr. Campbell De Morgan,[1] they occur under three forms. 1. As tumors having the appearance of a varicose state of the veins, unconnected with the muscular tissue in which they lie, but yet not isolated by any well-defined covering of connective tissue. 2. As erectile tissue, forming in, and encroaching on, the muscular fibres, from which it is not separated by any defined boundary. 3. As erectile tissue, forming a defined tumor, having an investment of connective tissue not continuous with the muscular substance in which it is embedded.

The disease is most frequently congenital, but may come on later in life, after injury, or without any assignable cause. It is more commonly seated in the muscles of the lower extremities. The origin, mode of growth, and true structure have not yet been satisfactorily ascertained; but it either spreads through the muscular tissue or occurs in the form of isolated tumors. The muscular fibres on which it encroaches are compressed by the hypertrophied vascular and connective tissues, and their nutrition being impaired by the altered and thickened state of the capillaries, they degenerate to a greater or less extent, and become transformed for the most part into fat, while the connective tissue increases in quantity, and is in some places condensed into masses or bands, which, when they form at the circumference of the tumor, constitute its fibrous sheath. There appears, also, to be an increase in the quantity of yellow elastic tissue. The changes which occur in the vascular tissue itself are not well understood.

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[1] For a recent and elaborate description of the nature and treatment of trichinosis, see a paper by Dr. Thudichum in the Seventh Report of the Medical Officer of the Privy Council, 1864. Also a shorter paper by Dr. Althaus, in the Medical Times and Gazette, 1864.

[1] British and Foreign Medico-Chirurgical Review, 1864, p. 187.

Sometimes the disease shows itself in a number of different places in the same subject, as in cases recorded by Cruveilhier; in one of these the hand and arm were covered with innumerable small tumors, varying in size from that of a small shot to that of a large bean. They were all composed of erectile tissue. It is generally allowed that vascular tumors are very prone to degenerate into cancer.

Scirrhus seldom originates in muscles, except in the tongue and substance of the lip. [It is very doubtful if any form of cancer ever originates in muscle; and the cases referred to in this and the succeeding paragraphs, as those of melanotic and encephaloid carcinoma, were in all probability of sarcomatous nature.] Warren describes a case of what he terms scirrhus of the muscle, which resembles more the account given of the syphilitic tumor described as having been removed from the shoulder by Mr. South. Muscles readily become implicated in the disease occurring in neighboring parts, and it is not unusual to find the muscles for a considerable distance around a scirrhous breast dotted with scirrhous tubercles. Melanosis must be very rare in muscles. Warren mentions a case occurring in the muscular structure between the base of the scapula and the spine; this had been removed, but a second tumor appeared in its place under the cicatrix; it was found, on operating on it, to be seated in the substance of the rhomboid and trapezius muscles; it was hard in structure, and the interior composed of black matter; six months after this, the disease reappeared, of a carcinomatous appearance, and proved fatal.

Encephaloid tumors no doubt originate in muscles, though they grow so rapidly, and involve every structure so indiscriminately, as to make it difficult, except in certain organs, to define their origin. Warren, speaking of this disease in muscles, describes three cases. These, however, are not clearly proved to have sprung from muscle, except the last, which had its seat in the lumbar muscles.

AFFECTIONS OF TENDONS.

Injuries of tendons.—It has been already observed that tendons are ruptured by the action of their muscles more readily than the muscles themselves; they may also be ruptured by direct force, as in dislocation, and they are often divided partially or entirely in wounds, and by subcutaneous sections. When a tendon is ruptured, or, what is nearly the same thing, divided by subcutaneous operation, the part which is attached to the muscle is drawn away from the opposite end for about an inch; this latter is but slightly retracted by the action of its antagonists. Blood is poured out between the ends, but much less than in rupture of muscles. The pain is said to be not very great; a considerable shock, however, is felt, as from a blow received on the part, accompanied by cramp of the muscle, and a perfect inability to use the limb; and in rupture of the tendo Achillis a feeling is described as if the heel were sinking into a hole in the floor. The tendons most frequently ruptured are the tendo Achillis, and the tendons of the rectus femoris and the triceps humeri. If the separation of the ends be not too great, either in rupture or subcutaneous division, they unite with much readiness, the new material soon acquiring great firmness. So rapidly is the process of repair carried on, especially in the early stage, that, according to Mr. Paget, in his sixth lecture at the College of Surgeons, a specimen six days after division (being the fourth occupied in the organizing of the new structure) could bear the weight of twenty-five pounds; in another case the new material at the end of twenty-one days bore a weight of fifty-six pounds. The process of repair is briefly this, according to Mr. Paget (loc. cit.). For the first forty-eight hours inflammatory matter is poured out, and infiltrates the tissues between the ends; after this there ensues infiltration of a material of the character of the fibrin of the blood in a solid state, in which are enclosed the unabsorbed remains of the clot of extravasated blood, and the two ends of the divided tendon; this by degrees assumes a definite cord-like form; but even in five or six days it shows a nucleated structure, tending to the production of tendinous tissue. On the tenth day, the material becomes paler and less vascular, and assumes a distinctly filamentary form; and in about three weeks there is a perfect cord, of the nature of tendon. Mr. Paget goes on to remark, that in the further stage of the process the ends of the tendon swell and soften to the consistence of the effused matter, so that they may merge one into the other, assuming thereby a closer adhesion. He also remarks, that the repair of the tendon does not depend on the non-division of its sheath, as has been supposed. Should the interval between the two ends of a divided tendon be great, a very imperfect bond of union will be established between them, as the end will become attached to the neighboring tissues, and either a partial or entire loss of the use of the muscle will result. Where the integuments and surrounding parts are included in a division of a tendon, there is, as in muscle, a much greater retraction than where these parts remain entire; added to which, the material for the repair of the tendon being here common to all the other tissues included in the wound, they all become fused in a common cicatrix, so that under the most favorable circumstances a very imperfect union and limited use of the muscle ensue.

The treatment of ruptured tendon consists, as in rupture of muscle, in approximating the divided ends, and retaining them in that position until firm union is established. Close adaptation cannot be hoped for, but still a perfect union with recovery of the action of the muscle usually takes place. The severed ends are brought closer and closer toward one another by the contraction of the new material as it becomes perfected, and the remaining deficiency is fully compensated for by the accommodating nature of the muscle. If the tendon of the triceps be torn, all that is required is a bandage from above downward, with a splint in front of the arm to keep it extended: and as the union of tendon is rapid, passive motion may be employed early. In rupture of the tendon of the quadriceps extensor cruris, the same treatment nearly may be adopted as for a fractured patella. Where the tendo Achillis is torn across, the treatment consists in keeping the foot extended on the leg, and the leg bent on the thigh; a position favorable to the relaxation of the gastrocnemii muscles. For this purpose a belt is placed round the thigh a little above the knee, the back of which is attached to the heel of a slipper by means of a belt or bar. Before applying the instrument, the calf of the leg should be bandaged from above downward, care being taken not to approach too near the seat of rupture, for a great displacement and permanent defect would result from the ends of the tendon being pressed towards the bones of the leg; somewhat of a similar inconvenience may occur from a too considerable or a too long-continued tilting up of the heel. Desault, to avoid the displacement of the tendon by his bandage, which, like Petit's, extended over the whole limb, recommends compresses at the sides of the tendon. John Hunter, who himself had a rupture of the tendo Achillis, recommends that, as so little inconvenience attends a small separation of the tendon, compared to the great inconvenience and difficulties attending the treatment by bandages and straps, the parts should be allowed to remain in their natural position. He is, however, disposed to adopt a medium between the two, and suggests that the heel should be elevated during walking, by raising the heel of the shoe; that a bandage should be kept steadily applied to the calf of the leg, to guard against involuntary actions of the muscles; and that at night the usual slipper and strap might be applied. When the integuments and surrounding parts are included in the division of a tendon, the edges of the wound may be brought together by adhesive plaster, or perhaps by sutures. The mode of bringing the divided ends of the tendon together by means of sutures can scarcely be recommended, as they produce irritation, and keep the wound open. Bandages are not well borne; rest, therefore, with position, must mostly be trusted to for the cure.

[The immovable dressing has been very successfully employed in the treatment of ruptured tendon. Few surgeons at the present day will agree with the author in saying that the use of sutures "can scarcely be recommended," as in many recorded cases complete recovery has followed their employment, and not so very seldom satisfactory results have been secured by attaching the lower end of the damaged tendon to an adjoining tendon.]

Inflammation of tendons.—Tendons, together with their sheaths, both fibrous and synovial, are not unfrequently inflamed. Independently of gout and rheumatism, the most frequent cause is a sprain or wrench in the neighborhood of a joint. These injuries are occasionally productive of long-continued wearing pains, assuming much of a rheumatic character, and yield, often slowly and unwillingly, to the remedies, both local and general, employed in rheumatism. Sometimes these sprains are followed by inflammation, with great effusion into the sheath and surrounding cellular tissue (especially in the region of the foot and ankle), which, either rapidly in an acute form, or slowly in a chronic form, may extend to the ligaments and periosteum, destroying the joints, and producing caries of the bone.

Under the name of "ténosynite crépitante," the French describe a slight degree of inflammation of the sheaths and investments of the muscles and tendons: it follows long-continued and fatiguing muscular exertion, and for the most part occurs in the muscles of the forearm. I have observed it mostly in the extensor muscles of the thumb as they pass over the radius; it is usually accompanied by considerable pains extending up and down the limb, and a well-marked crepitating or creaking feeling can be felt by grasping the part while the muscles are in action. The treatment consists in complete rest, and stimulating or even vesicating applications. In one of the forms of whitlow, *paronychia tendinosa* of Abernethy,[1] the tendons and their sheaths in the finger and hand are the seat of a severe and often most destructive inflammation, which, though often confined to one finger, not unfrequently extends to the hand and arm, attacking not only the tendons and softer parts, but exposing the bones and disorganizing the joints. It arises from the same causes as the other forms of paronychia, slight wounds, pricks, with or without inoculation of irritating or poisonous matter, and often without any evident cause, though doubtless, depending much on the state of the general health. It begins with severe and throbbing pain on the palmar face of a finger, which extends along the arm, often to the shoulder; it is accompanied by redness and swelling, with great hardness and tension: if not checked, the inflammation proceeds quickly along the front of the finger, and is soon followed by suppuration in the sheath; this at first is in small quantity, and, in consequence of the great hardness and swelling of the part, cannot be detected by the touch; if no relief be afforded, the suppuration quickly proceeds along the sheath, the inflammation and pain are aggravated by the density and unyielding nature of the parts, and are accompanied by much constitutional disturbance; abscesses burst externally from time to time as the disease extends along the sheath, from which fungous granulations spring, the tendon in a sloughy state lying at the bottom. With proper treatment, and in a favorable state of the general health, the progress may be arrested with a greater or less amount of destruction of the parts attacked, and a proportionate deformity. In certain unhealthy states of the system, however, in which the diffuse or erysipelatous form of inflammation prevails, the inflammation and suppuration extend into the palm of the hand behind the palmar fascia, and to the rest of the fingers. The whole hand now presents a highly inflamed appearance, of an erysipelatous nature, with great swelling and tension; nor does the mischief end here, but passing under the transverse ligaments of the wrist, ascends into the forearm, forming large diffuse abscesses among its tendons and muscles; and in the worst cases not only the joints of the finger, but those of the carpus and wrist are destroyed, and the bones denuded and necrosed. The health during this time suffers severely from irritative fever, with gradual prostration of the bodily powers.

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[1] Lect. xxviii., Lancet, April 29, 1825.

Treatment.—In the very early stage the inflammation may often be arrested by leeches, followed by hot fomentations to soften and relax the hard and unyielding tissues. The hand should be elevated, and an active purgative, with other antiphlogistic measures, prescribed; if relief do not soon follow, but, on the contrary, the continuance of pain and throbbing with increased hardness indicate the extension of the inflammation, if not the formation of pus, no further time must be lost; a free incision must be made along the centre of the finger, and though there may be but very little or no pus in the sheath, yet the division of the tensely strangulated structure, and the escape of blood and serum, afford the greatest relief. By these means all mischief may be arrested, and the finger perfectly restored. On the other hand, the inflammation may proceed along the sheath in spite of the most ready treatment; suppuration may have extended under the palmar fascia; further incisions must then be made; and it will now be found proper to support the powers of the system by a generous diet, stimuli, and tonics. In these cases the tendon will slough, and one or more of the joints will be ankylosed, with such disfiguration as may at a future time require amputation; for a stiff and distorted finger, in almost any condition of life, is very inconvenient as well as unsightly. In the more chronic states, where, notwithstanding free openings having been made in the palm, abscesses burrow about the hand, I have found the best results from pressure with pads of lint soaked in pure liquor plumbi, and a bandage, the powers being supported with tonics, good diet, and stimuli. Where the suppuration extends to the arm, the case is more serious; and if, from the state of the constitution before alluded to, it proceeds to the indiscriminate destruction of the joints, nothing but amputation remains, and even that may not save life.

Mr. Tatum has amputated the forearm twice for this disease; the first case was in a gardener, a patient at St. George's Hospital. He seemed healthy and strong, but the diffuse suppuration extended rapidly along the sheaths to the hand and arm, destroying the joints of the hand and wrist, in spite of every endeavor to arrest the disease; and though amputation was performed before the powers were very much prostrated, it was only by constant attention and active treatment that after a long time the man recovered. The other case was that of a gentleman, aged fifty-five, whom Mr. Tatum attended with the late Mr. B. Cooper and Mr. H. Phillips: he was of a bad habit of body, pale and flabby, with a weak pulse; the suppuration, beginning in the little finger, spread with surprising rapidity along the sheath, quickly involved the other fingers, then the hand and forearm, destroying the joints in its course, in spite of free incisions and whatever could be devised in the way of support. Nothing produced the slightest check to the progress of the inflammation, nor any reaction of the system; it was therefore agreed that the arm should be amputated. Mr. Tatum performed the operation unusually high up in the forearm, with a view to cut through sound parts; but even at this height the knife passed through the extremity of an abscess. No reaction took place after the operation; the stump soon assumed a flabby, half-sloughy state; and after some days the patient sank.

It has been already remarked that tendons, as well as muscles, are the seat of syphilitic enlargements. In one of the cases recorded by Mr. Tatum, the tendinous origin of the sterno-cleido-mastoid was much thickened. M. Bouisson (loc. cit.), describing these swellings, remarks that they are formed by deposit between the fibres, as in muscles. He also relates a case of strabismus from a syphilitic tumor occurring in the tendon of one of the muscles of the eye. M. Lisfranc[1] speaks of certain node-like swellings on the surfaces of tendons, which he calls "nodosités blanches des tendons." Syphilitic enlargements of tendons do not, as in muscles, readily yield to the internal use of the iodide of potassium; they require an active local treatment as well, such as iodine and mercurial ointment, or blisters kept open with mercurial ointment. Swellings of the tendo Achillis occasionally occur without a syphilitic origin. Mr. Tatum has found them in persons who have taken long and fatiguing walks, not having been accustomed to much exertion. These swellings sometimes occur as a simple rounded enlargement in the tendon, and sometimes as an irregular thickening; they are tender when handled, and are sufficiently painful in walking to make the patient limp. These tumors are often troublesome to cure, as they do not readily get well without rest, and the pain and inconvenience are not usually sufficient to induce the patient to lie up; in order, however, to cure them it will generally be found necessary for the patient to lie up, or at all events to avoid using the part, and to apply the local means recommended in syphilitic tumors, as blisters kept open with mercurial ointment, or the emplastrum ammoniaci cum hydrargyro, etc.

Tumors of tendons.—Malignant tumors do not often spring from tendon [such tumors being always sarcomatous]; it offers, on the contrary, like other fibrous structures, a lengthened resistance to their progress. Warren gives the following account of a malignant tumor growing in the substance of tendon: A round and prominent tumor appeared above the patella, three inches in extent, without much pain or sensibility, but causing lameness; it had been growing six months. On cutting down, the fibres of the rectus tendon, which were stretched over the tumor, were separated, exposing a white fungous growth firmer than the ordinary fungous tumor, but breaking in pieces when handled. On removal, it was found to be mixed up with fasciculi of tendinous fibres. It showed no disposition to bleed. This tumor returned after the healing of the wound, and was again removed, when it presented a more decidedly fungoid character, with fewer tendinous fibres. The case terminated fatally, with the formation of tumors within the abdomen. Fibrous tumors occasionally arise in tendinous structure, as in fasciæ, and other parts of a fibrous nature. Small cartilaginous enlargements are often found in the course of tendons, especially those of the hand and foot; they do not grow to a large size, and seldom produce any inconvenience. Small growths, described as tæniophytes by Albers,[1] are sometimes found growing on the surface of tendons near their junction with their muscles; they vary in size from a pin's head to a cherry; they are at first altogether cartilaginous, but as they increase in size calcareous matter is deposited in them, as in the development of bone.

AFFECTIONS OF BURSÆ MUCOSÆ.

The closed synovial bags called bursæ mucosæ are of two kinds; those situated in the subcutaneous cellular tissue, and those connected with tendons. The subcutaneous bursa is formed of cellular membrane that has been exposed to friction and pressure, by which its cells are obliterated and a single cavity formed; it retains, in part, the form of its cellular origin, for even after great distension the interior often presents a sacculated or multilocular appearance. Like cellular membrane it has much of the character of serous membrane, in its ordinary state exhaling a fluid little denser than serum, but assuming, after a time, much of the nature of synovia. The subcutaneous bursæ are numerous,[2] and are either normal or adventitious. The normal occur mostly between the skin and some bony prominence. The adventitious bursæ are formed below corns, bunions, or other accidental callosities, as those arising in talipes on the sides or back of the feet. These sacs are liable to become enlarged from various causes, mostly local, as pressure, friction, or blows, though occasionally constitutional. The bursa in front of the patella is most frequently the seat of enlargement, forming a tumor familiarly known as *the housemaid's knee.* The contents of these enlarged cysts vary much; at first they are distended with a fluid little more dense than serum, gradually acquiring more and more the nature of synovia; it is often mixed with blood, either recent or in a thick grumous state; sometimes there is a dark-brownish adhesive fluid containing cholesterine; occasionally, after long-continued pressure, fibrinous matter is deposited within the sac, something after the manner of an aneurism, which gradually fills up the cavity, forming a tumor of a dense fibrous structure; sometimes it is solid throughout; more frequently there is a central cavity containing a gelatinous fluid. Sometimes the fluid in an enlarged bursa contains numerous bodies, resembling melon-seeds or parboiled rice; these are of a dense, fibrinous nature, and appear to be either the result of broken-up deposit, the portions becoming round and smooth by motion and attrition, or productions from the inner surface of the fibrous deposit, which from the effects of motion and friction become first pedunculated, and then, being detached, fall loose into the fluid of the sac, much in the same way as occurs in the formation of loose cartilages in joints. Inflammation, terminating often in suppuration, sometimes takes place in bursæ mucosæ; we see it occurring in a previously healthy state of the part, after a severe blow or a wound, especially in the bursa over the olecranon; the inflammation runs very high, and is not confined to the sac itself, but, in a diffuse form, extends often over the whole arm, with much swelling, redness, and tension; the pain is great and the constitutional disturbance considerable, and in old people there is sometimes much danger. Pus forms rapidly, not only in the sac but also in the cellular membrane, if not relieved. Enlarged bursæ of the patella are frequently attacked by inflammation and suppuration, and usually there is extensive inflammation of the surrounding cellular structure; and sometimes such large collections of pus are found in the neighborhood of the sac, as led Sir B. Brodie to consider that the suppurating bursa occasionally gave way, and allowed its contents to escape into the cellular membrane. The readiness with which the neighboring cellular membrane is involved in the inflammation of subcutaneous bursæ, is probably due as much to the sameness of their nature as to the continuity of their tissue. Troublesome and burrowing ulcers sometimes remain after these abscesses, and sometimes from undue pressure and neglect of a hardened cyst. The ulcerations are singularly obstinate, sometimes with considerable fungous growths, the skin around being dark and unhealthy, with deep burrowings under the integuments about the knee, and a foul and offensive discharge.

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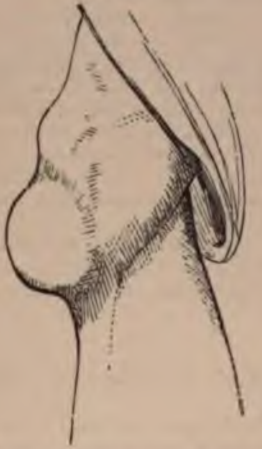
[1] Gazette des Hôpitaux, No. 1842.

[1] Vidal, Pathol. extern., vol. ii., p. 763.

[2] Ibid., vol. i., p. 595.

[Fig. 744.



Enlarged bursa over the patella, the result of pressure; housemaid's knee (Liston).

[In many cases of abscess of the præpatellar bursa, the resulting troublesome ulcer is due to imperfect drainage of the abscess-sac, the opening being made simply over the top of the patella instead of at its sides. By making lateral incisions, securing thorough drainage, and immobilizing the knee, a comparatively early and very complete closure of the cavity can usually be secured.]

Treatment.—Whatever treatment may be adopted, it should be accompanied by complete rest. When the bursa over the patella is affected, a well-fitting ham-splint may be applied, and all motions of the knee-joint prevented. Simple enlargement, if recent, will often subside under rest and a slightly stimulating lotion, such as ammoniæ hydrochlorat. ʒj, aquæ ℥v, aceti ℥j, M. Some merely transfix the bursa with a needle, and leave it to itself. If the enlargement has been of some duration, with thickening, more decided measures will be required. Some surgeons evacuate the contents by puncture, and follow it by pressure with a pad and strapping; the sac is likely, however, to fill again, and will require repeated punctures. Counter-irritants often effect a cure, such as the emplastrum ammoniaci cum hydrargyro, or a blister over the part. The iodine ointment or the tincture of iodine applied to the skin over the tumor, may in some cases succeed, especially where the contents have been previously evacuated.

Mr. Key[1] recommends a seton, composed of a few threads of silk, to be passed through the cyst; suppuration is thus set up, and the pus escapes on moving the threads from time to time; compression is also employed by means of a pad and adhesive plaster, the openings being left free. By these means the discharge gradually diminishes, and, partly by contraction and partly by granulation, the cavity becomes obliterated. The French surgeons often treat these cases with iodine injections, like hydrocele. When there is much solid deposit in the sac, Mr. Key still finds the treatment by seton the most effectual; for, considering that the induration is kept up by the irritation of the cavity, the seton, by producing inflammation and suppuration, would cause its obliteration, and the absorbents would remove the indurated walls. When the tumor has become almost or quite a solid, gristly mass, there is no remedy but dissecting it out, which can readily be done without any bad consequences. Where the tumor is very large, and overlaps the patella, care should be taken not to wound the aponeurotic covering of the joint.

In acute inflammation of the bursæ, both local and general antiphlogistic measures are required; but where there is diffuse inflammation around, of an erysipelatous tendency, much benefit is derived from the sesquichloride of iron lotion,[2] with general support. If suppuration has taken place in the sac, it may either be laid open with a free incision, or a seton may be passed through it; the former would be preferable where there is much surrounding inflammation, as it not only gives free exit to the matter, but diminishes tension, relieves the vessels of blood, and the cellular membrane of the effused serum, and often prevents it from running into suppuration. If pus have already formed in the cellular tissue, it will probably be necessary to make one or more incisions for its escape, in as depending a position as possible, and the system will require general support and stimuli.[3]

The bursæ of tendons have more the character of synovial membranes than the subcutaneous bursæ, and are either simple bags containing a lubricating fluid, placed between tendons and prominences of bones, as that between the ligamentum patellæ and the tubercle of the tibia, or complicated with numerous processes and elongations, as in the synovial sheaths of the flexor tendons of the hand and wrist. These, like the subcutaneous bursæ, are liable to enlargement, and often attain a considerable size; but, from their deeper situations, they are less exposed to injuries from without, and consequently do not so frequently inflame and suppurate. The bursa between the ligamentum patellæ and tibia sometimes enlarges and forms a tumor, which, by filling up the depression on each side of the ligament, presents the appearance at first of synovitis of the knee-joint; but the absence of swelling above and around the patella renders the diagnosis easy. Distension of the bursa above the knee usually accompanies synovitis, because this bursa almost always communicates with the joint; this, however, is not always the case, and Mr. Tatum has seen a large bursal tumor under the vasti, the joint being quite healthy. One of the bursæ of the hamstring muscles (usually that of the biceps) occasionally enlarges, and appears in the ham as a pulsating tumor, often of considerable size; it is, however, too little like an aneurism to be mistaken for one by a careful observer. The same may be said of the bursa of the subscapularis, and other bursæ about the shoulder-joint, which sometimes form tumors in the axilla, occasionally pulsating from their vicinity to the artery. The bursa between the psoas and iliacus internus and the capsule of the hip-joint sometimes forms a tumor, which from its situation may be mistaken either for an inguinal aneurism or for a psoas abscess; the extrinsic character of the pulsation and the absence of all other aneurismal symptoms in the one case, and the want of spinal symptoms and of fluctuation above Poupart's ligaments in the other, assist in forming a right diagnosis. This bursa occasionally communicates with the synovial membrane of the joint, and when inflammation occurs in the former, the latter will most likely be involved in it, and serious mischief may follow. The bursa between the gluteus maximus and tuber ischii, that between the tendon of the gluteus medius and the trochanter, and that between the latissimus dorsi and the angle of the scapula, from their exposure to pressure and other sources of irritation and inflammation, are not only liable to inflame, but even to suppurate. When, from frequently recurring pressure in sitting, the already enlarged ischio-gluteal bursa inflames and suppurates, it increases in size, becomes painful, and renders sitting on the part impossible, and even motion distressing; lying deep under the mass of muscle, its fluctuation is obscure, and the suppuration is usually slow in coming to the surface, and after it is evacuated, it often leaves a sinus obstinate and slow to heal, from its depth and the movements of the muscle. The same may be said in most respects of the bursa over the trochanter. The bursa at the angle of the scapula often acquires a great size, and when it suppurates, much constitutional disturbance is often set up. Too much caution cannot be taken in opening these bursæ, whether in their simply enlarged state or in the suppurating stage, as an alarming and even fatal train of symptoms sometimes follows this operation.[1]

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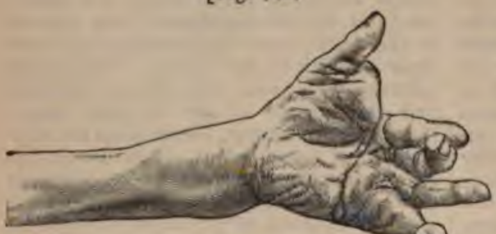
[1] Guy's Hosp. Rep., vol. i., p. 415.

[2] Tinct. ferri sesquichlor. ʒj., aquæ destillat. ℥viij.

[3] For bunion see SURGICAL AFFECTIONS OF THE SKIN.

The palmar bursal tumor is perhaps the most obstinate of any; forming a swelling under the palmar fascia, it extends under the transverse ligament and ascends into the forearm, presenting a double tumor, the contracted part corresponding with the transverse ligament. The fingers are more or less drawn into the palm of the hand, and cannot be straightened. The fluctuation is readily felt by alternate pressure above and below, and when, which is often the case, the melon-seed bodies are present, a peculiar creaking or grating sensation is communicated to the touch. These bodies are often extremely numerous; Dupuytren believed them to be hydatids, and described their appearance minutely.[2] These tumors, after slight attacks of inflammation, often cease to fluctuate, and become filled with solid, unorganized fibrin; and when inflammation, followed by suppuration, comes on, which it usually does from using the hand in this state, large masses of the coagulated substance may be squeezed out through the opening made to let out the pus; this has been followed by the gradual subsidence of the abscess, and the perfect restoration of the use of the hand. Sometimes, however, the case takes an unfavorable course; diffuse erysipelatous inflammation is set up instead of that of a more plastic nature, and a fatal result will occasionally ensue.

[Fig. 745.



Ganglion involving all the flexor tendons of hand and wrist.]

A patient was admitted under Mr. Tatum's care into St. George's Hospital with disease of this bursa. He was a publican, about fifty years of age, of a stout flabby appearance, with failing pulse; the bursa, which had suppurated, had been opened above and below the wrist, and was discharging large quantities of pus mixed with the rice-like bodies in great numbers; the hand was enormously swelled, and the whole arm, extending above the elbow, enlarged, tense, and of a deep-red color. The case in many respects resembled that of diffuse thecitis formerly described, and, like it, proved fatal, in spite of every means to support the system that Mr. Tatum could employ.

[From the many reports published during the last few years it would seem that by the employment of the "antiseptic method" the danger of operative interference in these cases is reduced to a minimum.]

A modification of the bursa is found connected with the extensor tendons of the fingers and toes; these are termed ganglions; their cavities do not appear to communicate with the sheaths of the tendons, but are formed in the dense tissue investing the sheaths or the capsule of the joint.[1] [In the larger number of cases of ganglia these latter are developed in connection with the tendinous sheath-cavities, though they may communicate with joint-cavities, or arise from the dilatation of mucous bursæ.] They form small, round, movable tumors, rarely larger than a filbert, mostly at the back of the wrist; they are seldom painful, but the patient usually complains of a sense of weakness in the joint. They are found less frequently on the dorsum of the foot; here they present a more compressed form, and are less movable than in the hand. Mr. Tatum has seen them, on the outer part of the dorsum of the foot, more than two inches in diameter, broad and flattened. These cysts contain almost constantly a firm gelatinous substance, nearly as dense as the crystalline lens of the eye. Ganglia do not, like subcutaneous bursæ, arise from pressure; they sometimes follow a sprain, but usually appear without evident cause; they are generally slow in their growth, but now and then appear quite suddenly.

Treatment of enlarged bursæ of tendons.—These bursæ sometimes enlarge rapidly, under which circumstances they subside quickly by rest and evaporating lotions. The more common and chronic form of enlargement requires a more active mode of treatment. Sometimes a blister alone may be sufficient to cause their disappearance; this will be more effectual if the cyst has been previously emptied by puncture; and it may be advisable to keep the blister open. Compression after evacuation of the cyst may succeed in some cases. If they prove obstinate, they may be treated like a hydrocele, by injection of equal parts of tincture of iodine and water; this, however, should not be done in those bursæ which occasionally communicate with joints, nor perhaps in the bursa between the latissimus dorsi and scapula, for reasons already given. A seton often answers well, as in subcutaneous bursæ. The palmar bursa, when enlarged, as well as that at the angle of the scapula, requires some consideration as regards the health, powers, and condition of the patient before active measures are adopted for curing it; for it must be remembered that these measures effect a cure by setting up an active inflammation and suppuration; and it has been already seen how prone the inflammation is to take on a diffuse and most unfavorable form, especially where the bursæ are extensive. Where the tumor is not of long standing, it may often be much diminished, if not cured, by puncturing it, which may be followed by either compression or blisters. In a patient under Mr. Tatum's care with inflamed thecal bursa (a nurse in the hospital), blisters were kept open for some time; after two or three successive punctures the tumors were much diminished and felt solid, the cyst containing evidently coagulated fibrin alone; she was now enabled to use the hand and attend to her duties. At the end of a few months, however, the hand became painful and inflamed, and fluctuation was perceptible both above and below the transverse ligament; an opening was made in each part, and a small quantity of pus escaped, mixed with fragments of coagulated fibrin. Seeing this, Mr. Tatum enlarged the opening and squeezed out a large quantity of very firm straw-colored coagulum; the cysts being emptied, a poultice was applied, and a generous diet ordered. Considerable discharge took place for some days, but gradually diminished; the wounds healed, and so complete was the recovery, that but for the marks of the incisions, no signs of previous disease existed. It has been recommended to lay open the entire sac, dividing the transverse ligament, and dressing the wound to the bottom with lint. This treatment one would hardly recommend, though where the rice-like bodies exist, simple punctures will not give exit to them, and incisions must be made for the purpose. In some cases both the seton and iodine injections may be employed, but with extreme caution. The ganglion may be treated in various ways; it is apt, however, to return. If the walls are not very dense, the sac may be ruptured by firmly compressing it with the two thumbs, or it may be divided subcutaneously with a tenotomy knife, or punctured with a grooved needle, and the crystalline contents squeezed out. Whichever plan is adopted, the swelling will probably return, unless further means be employed, such as firm compression with a small solid body tightly bandaged over the part; or a blister may be applied over the part with a good effect. Boyer (loc. cit.) has described a case of very extensive ganglion connected with the extensor tendons of the fingers, which he dissected out and dressed to the bottom with lint, having previously failed in the treatment by seton and compression. The result of the operation was very favorable. These cysts, however, cannot be entirely removed by operation; the attached parts cannot be dissected from the tendon or ligament; so that they will return unless the wound be kept open to the last.

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[1] On the diagnosis between diseases of the bursæ and of the joints, see DISEASES OF THE JOINTS.

[2] Leçons orales, ed. 1839, vol. ii., pp. 140 et seq.

[1] See Boyer, Traité des Mal. Chir., vol. xi.

["Free incision under strict antiseptic precautions, thorough drainage and the promotion of healing by granulation" has had many advocates of late; such operative procedures being attended with but little risk, and assuring permanent relief.]

PART III.

DISEASES OF THE NERVOUS SYSTEM.

DISEASES AND INJURIES OF NERVES.
  PART I.—NERVE LESIONS AND THEIR MORE IMMEDIATE EFFECTS.
  PART II.—REMOTER CONSEQUENCES OF NERVE-LESIONS.
LOCOMOTOR ATAXY.

PART III.

DISEASES OF THE NERVOUS SYSTEM.

DISEASES AND INJURIES OF NERVES.

PART I.

NERVE-LESIONS AND THEIR MORE IMMEDIATE EFFECTS.

By J. Lockhart Clarke, M.D.

Revised by Roberts Bartholow, M.D., LL.D.

Diseases of Nerves.

Nerves are subject to as many disorders and injuries as most of the other tissues of the body. They are liable to inflammation, suppuration, ulceration, and gangrene; to atrophy and enlargement; to softening and induration; to the formation of cysts, fibrous or neuromatous tumors, and cancerous growths along their course; to compression or stretching; to contusions, lacerations, punctures, and partial or complete division.

Inflammation of Nerves.

Inflammation of nerves is less common than that of most other soft tissues. It attacks in preference the sanguine and robust, and adults rather than children, in whom neuritis is rare. It may be either acute or chronic, and either idiopathic or traumatic.

Acute neuritis is generally preceded by the usual prodromata of inflammation. Its characteristic symptoms consist of a tearing, darting, or lancinating pain along the course of a nerve-trunk or its branches, attended with a sensation of tingling, formication, or numbness, which are sometimes followed by partial or complete paralysis of the muscles supplied by that portion of the nerve which is below the seat of inflammation. The pain never becomes *suddenly* severe or ceases suddenly, or intermits, as in non-inflammatory neuralgia; for although it frequently remits or abates, it is a continuous pain which gradually increases in intensity and gradually subsides. It is always aggravated by pressure on the inflamed portion of the nerve, by contraction of the muscles to which it distributes branches, or even by the slightest touch along its peripheral course; while, on the other hand, it is relieved by firm pressure above the seat of inflammation. Sometimes the nerve is swollen at the part affected, resembling a cord stretched along the surface of the limb. Usually the movements of the limb are much impaired, and there is often a convulsive agitation of its muscles. The pulse is frequently strong and quick, the temperature of the skin over the inflamed part is much increased, and there is generally a variable degree of sympathetic fever, in proportion to the size of the affected nerve and the intensity of the inflammation.

[As regards the symptomatic expression, the results of inflammation of nerves differ in sensory, motor, and mixed, or compound nerves. The symptoms also vary according to the stage of the disease and the extent of the mischief. When the sensory nerve is involved, pain in the peripheral expansion of the nerve is the most pronounced symptom, and alterations of nutrition may follow. The pain varies from a mere sense of soreness to an excruciating agony; but as is the case with non-inflammatory nerve-pain, the suffering is not always at the maximum, but is rather paroxysmal. If the inflammation proceeds to the destruction of the nerve, the peripheral pain ceases, or is not recognized by consciousness, and anæsthesia and analgesia are substituted. When neuritis involves a motor nerve, instead of pain, muscular rigidity or spasm results. All of the muscles innervated by the affected nerve are thrown into a state of forced flexion, extension, or merely spastic rigidity. If the inflammation proceeds to the destruction of the nerve, the symptoms of irritation give place to those of loss of function; in other words, paralysis succeeds to spasm. In the case of neuritis involving a mixed nerve, both sensibility and motility are affected; at first, the symptoms are those of irritation—pain and spasm; afterwards, anæsthesia and analgesia, paresis and paralysis, indicate the destruction of the nerve.

Neuritis manifests a tendency to spread from its original site in both directions—*neuritis ascendens, neuritis descendens.* The centripetal extension takes place strictly by contiguity of tissue, or by metastasis, and ultimately the spinal cord may be reached and its anatomical elements injured to a less or greater extent.

Very important trophic alterations occur in some cases of neuritis. Conjunctivitis, ulceration of the cornea, staphyloma, etc., are caused by an inflammation of the ophthalmic division of the fifth nerve. Herpes zoster, destructive ulceration of the skin, disease and deformity of joints, etc., succeed to inflammation of the peripheral nerves in various situations.

Besides these immediate effects, various reflex and remote disturbances ensue. Irradiations of pain occur, especially upwards and by means of the associated plexus of nerves, and muscular spasm and paresis in distant muscular groups, are produced by a reflex influence.

The electrical reactions of the affected nerves afford precise indications of their condition. When the stage of hyperæmia comes on, the electrical response of the nerves, both sensory and motor, is more ready than in the normal state. As the inflammation proceeds and the nerve elements are disassociated and destroyed, there ensues a quantitative decline in the reactions to both forms of the current. With the progress of the motor nerve changes, alterations of a peculiar kind occur in the muscles, and are now known as the "reactions of degeneration." Further on, these will be described with some detail.]

The seat of inflammation in neuritis is the neurilemma and the connective tissue between the bundles of fibres; and whatever changes the fibres may undergo are the consequences of deranged nutrition. When the inflammation has been of moderate intensity and not of long duration, the nerve has been found to be more or less altered in color, varying from a pale rose to a deep red, according to the greater or less amount of vascularity in the neurilemma and interfibrillar connective tissue. For the same reason, also, there is a variable increase in the diameter of the nerve, its component bundles being separated from each other more widely than usual; but the fibres retain their natural structure, or at least do not appear to have suffered any remarkable change.

The inflammation may either terminate in resolution or reach its greatest intensity. In the latter case, the nerve is extremely vascular and of the deepest or violet red throughout its entire thickness. Its volume is still further augmented, sometimes to twice or even three times its natural diameter. This is the result partly of the increased hyperæmia, and partly of the inflammatory products that are poured out. These products consist of sero-fibrinous or sero-sanguinolent fluids; of pure blood, or blood mixed with pus, infiltrated into the neurilemma and between the bundles of the nerve-fibres, which undergo disintegration or degeneration, in consequence of impaired nutrition. Sometimes the nerve is softened and easily torn, or even reduced to a pulp; at other times it is indurated and tense, from coagulation and hardening of fibrinous exudation. In some cases it is interspersed with minute ecchymoses, or with hard grains along its inflamed course; in other cases it is covered with small abscesses, or enveloped in pus or puro-sanguinolent fluids, or fibrinous exudation; or it contracts adhesions to contiguous parts.

Chronic neuritis may either result from incomplete resolution of acute inflammation, or be the continuation of a milder form. In either case it is a frequent cause of certain kinds of neuralgia, of neuroma, and of painful subcutaneous tubercle. Its morbid anatomy consists of an increased vascularity of the affected nerve; sometimes of a varicose state of its bloodvessels; of a thickening and induration of the neurilemma, in consequence of coagulable exudations. In a variable degree the nerve assumes a somewhat slate color, loses its characteristic opacity, and when examined under the microscope, the nerve-fibres are found to have fallen, to a greater or lesser extent, into a state of disintegration.

[In acute neuritis, the nerve-fasciculi are bathed in a serous or fibrinous exudation. On microscopical examination, besides a more or less intense hyperæmia, in the neurilemma are seen leucocytes floating in serum, and the medulla of the nerve-fibres is beginning to disintegrate. Suppuration next occurs, the nerve elements are disassociated and softened, the axis cylinder then disappears, and finally nothing remains but a brownish, or chocolate-colored, diffluent mass. When recovery occurs, the inflammation being less intense and destructive, the hyperæmia disappears, the liquid portion of the exudation is taken up, the solid matters undergo a fatty degeneration and are emulsionized, and slowly the nerve-fibres are restored. The process is different when the inflammation is chronic in character. Then the tendency is less to suppuration and softening, and more to increase of the connective tissue,—to sclerosis. Sometimes the connective-tissue hyperplasia is uniform, the whole nerve being thickened and indurated for a considerable distance, or the process occurs at particular places, so that the nerve assumes a fusiform or spindle-shape; or, again, it is enlarged at intervals, when it presents a knobbed appearance—*neuritis nodosa*. The inflammation may attack the sheath of the nerve, chiefly, and this contracts adhesions to neighboring tissues, the nerve itself remaining movable although compressed. In other cases the nerve as well as its sheath is the seat of the inflammation; in the growth of the new connective tissue, the proper nerve-elements are compressed, and consequently atrophy and disappear, nothing remaining but a fibrous cord. On microscopic examination, there is but little hyperæmia; the interstices are crowded with leucocytes and granular cells; but the most important change is the overgrowth of the interstitial connective tissue, and the consequent fatty and atrophic degeneration of the nerve-fibres with their axis cylinder. With the injury to the nerve occur the secondary trophic changes, and, if the nerve be motor in function, nuclear growth of the muscular fibres.]

Idiopathic neuritis, although much less common than traumatic, is, I believe, more frequent than it is generally considered to be. Its chief exciting causes are exposure to cold, to damp, and particularly to the combination of both; the suppression of profuse perspiration; the arrest of hemorrhoidal discharges; excessive bodily fatigue; strumous or tubercular affections, and sometimes visceral inflammations and suppurations.

Martinet relates the interesting case of a deserter—an athletic young man, who, after an obstinate chase through a wood, was captured by the gendarmes, covered with sweat, and in a state of wild excitement. On the third day after his capture, he was unable to sustain himself on his legs, and experienced an excruciating pain along the back of his thighs, in the course of the sciatic nerves. Soon after, the patient was attacked with pneumonia, and died on the eighth day of his illness. On post-mortem examination, both sciatic nerves were found to be as thick as the index finger, and hard and resisting. All their component bundles were separated from each other by a sero-sanguinolent fluid, and were penetrated by a multitude of blood-vessels, which imparted to the nerve a deep-red color.[1]—Gendrin mentions the somewhat similar case of a man who walked from Lyons to Paris. During the last two days of his journey, he experienced a dull pain in the course of the right sciatic nerve. The right leg became entirely useless, and the patient died in a fortnight. On examination, the right sciatic nerve was found to be of a deep rose color at one part, and of a deep red at another. It was infiltrated with serous fluid, and three times its natural diameter.[2]—Martinet has recorded nine other cases of idiopathic inflammation of nerves, the most important of which I will very briefly describe.

CASE 1. Violent and continuous pain in the course of the left cubital nerve, without impediment to the muscular movements. The nerve attained the size of the little finger, and appeared like a cord stretched along the arm.

CASE 4. A woman previously in good health began to have pains along the left arm. These pains gradually became violent and extended to the fingers. First weakness, and then paralysis of arm with numbness. A blister to the inner side of the arm brought back the power of movement, which, however, was again lost, with increase of pain, as soon as the blister healed. Eight or ten days later, pain was felt in the opposite arm, but the power of movement remained. After some months, during which her condition varied, she had acute pain in the right *lower* extremity, followed by loss of motion. A slough formed on the sacrum, and death ensued a few days later. On post-mortem examination the spinal cord was found healthy, but the median nerve on the left side, at its separation from the other branches of the brachial plexus, was of a deep red color *throughout its entire thickness*, for about two inches in length. A nearly similar condition was found in the anterior branch of the seventh cervical nerve, which contributes to form the median. The right *sciatic* nerve, enveloped in a large quantity of gangrenous areolar tissue, presented, at its superior part, and for a length of about two inches and a half, a deep brown color through its whole thickness, but without any alteration of either its volume or consistence.[3]

From this interesting case, we learn that nerves situated at a distance from each other may consecutively and independently become affected by idiopathic inflammation.

Mr. Earle,[4] Sir Charles Bell,[5] Barensprung,[6] and others, have recorded interesting cases of idiopathic inflammation of nerves. Barensprung's case was a scrofulous child, one year old, in which both roots of the sixth, seventh, and eighth intercostal nerves were found enlarged and red.—Martinet's eighth case was also a child, twelve years old, who had for some time shown the characteristic symptoms of phthisis, and in whom there was violent inflammation of the left sciatic nerve. The child died in about seven weeks in a complete state of marasmus. On examination, numerous tubercles were found in both lungs, the greater number in a state of suppuration. The left sciatic nerve was not sensibly increased in volume, but the whole of its upper third was embedded in sanious pus, which separated it from the surrounding muscles. The same kind of pus was found between its bundles. This case and the preceding one are particularly interesting from the fact of their occurring in children, in whom neuritis is rare.

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[1] L. Martinet, "Mémoire sur l'Inflammation des Nerfs," Revue médicale, 1824, tome 2^{me}, obs. v.

[2] Gendrin, Histoire anatomique des Inflammations, tome ii., pp. 143–4.

[3] Martinet, loc. cit.

[4] Med.-Chir. Trans., vol. vii.

[5] Dr. Cooke, On Palsy, p. 98.

[6] Annalen des Charitekrankenhauses.

Traumatic neuritis is much more common than idiopathic. As the term implies, it is the result of some external injury, such as wounds, contusions, fractures, dislocations, surgical operations, etc. According to my own observations, it is less frequently fatal than the idiopathic form.

Treatment of neuritis.—The most important remedies to be employed in the treatment of *acute* neuritis, are the local abstraction of blood by means of cupping or leeches; evaporating lotions or anodyne fomentations; a spare diet with the use of purgatives; tartarized antimony, opiates, belladonna, and the preparations of aconite. When there is reason to believe that the inflammation is of a gouty, rheumatic, or syphilitic character, colchicum, iodide of potassium, or perhaps mercury, should be employed. In cases where it is complicated with serious internal disease, or associated with a low cachectic condition, the treatment must be modified accordingly.

In *chronic* neuritis repeated blisters along the course of the nerve sometimes afford great relief. Anodyne fomentations, and especially liniments of aconite, belladonna, chloroform, and opium, are frequently of signal service. At the same time attention must be directed to the state of the general health. Vegetable and mineral tonics, iodide of potassium, and mild aperients are sometimes indispensable.

Ulceration of nerves, as a primary affection, appears to be unknown; but nerves in the neighborhood of ulcers are liable to become involved in the morbid process, and then they are generally the cause of intense and protracted suffering.[1] In such cases, the surrounding soft parts are often enlarged, the skin increases in thickness, the muscles and tendons share in the ulceration, and even the bones increase in dimensions. On either side of their ulcerated portion the nerves are generally thickened, sometimes to nearly double their natural diameter.

When these ulcers are exceedingly painful, Mr. Swan recommends the use of ointment made with powdered opium, or lotions made by mixing well-powdered opium with water, or lime-water. These should be applied on lint, and then a folded cloth moistened with water, or laudanum and water, should be placed over the surrounding skin; at the same time the digestive organs should be regulated. When other remedies have failed, and the disease is confined to the soft parts, excision of a portion of the nerve will be advisable, but if the bone be affected by caries or necrosis, amputation may be necessary. Mr. Swan recommends, that in excising a portion of the nerve, the operation should be performed as far as possible from the ulcer, because there is then a much greater probability that the external wound will heal by the first intention, and that consequently the cut ends of the nerve will escape inflammation and ulceration. It is also advisable to divide the nerve as near the upper part of the wound as possible, as the end of the nerve will thus retract from the wound, and consequently be less liable to become inflamed, should the external parts have assumed this disposition.[1]

Tumors of Nerves.

Of all the morbid growths that are found in connection with nerves, tumors are by far the most frequent. They vary considerably both in size and structure, but are commonly a source of acute pain and of the most distressing nervous affections. The smallest kind are known as *painful subcutaneous tubercles;* the larger kind as *neuromata.* The former are either more or less spherical, or oval, or fusiform, and sometimes rather flattened. Their color is generally white, but occasionally there is a brownish tint on their surface or in their interior. They are always firm, sometimes hard, and have a fibrous or fibro-cartilaginous structure. Their size varies from that of a millet-seed to that of a pea or a grain of oat. They are situated in the subcutaneous areolar tissue, and are generally more or less imbedded between the fibres of the nerves, which are separated and stretched over them. Sometimes, also, they have a close connection with a subcutaneous vein in the neighborhood of the nerve. They are generally solitary, and mostly confined to the upper or lower extremities, especially the former. Women are more subject to them than men; of eighteen cases collected by Wood, fourteen were women.

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[1] Nerves sometimes ulcerate in consequence of the pressure of tumors, etc. A striking case of ulceration of the sciatic nerve, produced by pressure of aneurism, which extended backward from the right groin, is recorded by Morgagni, De causis et sedibus Morborum, epist. 50, p. 11.

[1] Swan, on Diseases of Nerves etc., p. 83, 2d ed.

It is not easy to determine the cause or mode of origin of these tubercles. They appear in many instances to be the result of chronic inflammation, and have been found to follow certain injuries of nerves, especially contusions. When once deposited, they seem to grow with some rapidity, but may then remain stationary for a number of years.

This small subcutaneous tubercle is a source of the most acute pains, which dart like electric shocks along the course of the nerve, sometimes in both a peripheral and central direction. The pains recur very irregularly, and last, at each attack, from ten minutes to two hours or more. They begin gradually, increase in intensity, and gradually decrease, leaving the tubercle and its surrounding parts more or less tender to the touch. They are frequently excited or aggravated by changes in the weather from hot to cold, or the reverse, by storms, etc., and sometimes by mental emotions. The paroxysms may be repeated several times a day, or there may be remissions of days or even weeks. In many instances the tubercle is not tender to the touch except during the attacks, which are much aggravated by pressure.

In all cases of obstinate neuralgia, especially of the extremities, a careful search should be made for the possible existence of tubercles.

Valleix relates the case of a lady who suffered for fourteen years from acute pain in one of her knees, which no kind of treatment succeeded in relieving, until M. Cabaret, on carefully examining the part, discovered a small tubercle about the size of an oat attached to a cutaneous nerve.[1] After its removal the pain entirely ceased.—Marjolin furnished Descot with notes of a remarkable case of painful subcutaneous tubercles of the scrotum. A robust man, thirty years of age, had complained, for more than a year, of sharp, lancinating, and intermitting pains in the right side of the scrotum and inner side of the corresponding thigh. On examination, he found in the areolar tissue immediately beneath the skin of the scrotum, several small, smooth, lenticular, movable, hard, and isolated bodies. When compressed between the fingers, they caused the same kind of pains as the patient was accustomed to feel. A small incision of the skin was made over each of them, and they were easily extracted by compressing the edges of the incision. The operation was followed by a complete cessation of the pains.[1]

Neuroma.—Neuromatous tumors, although they differ from each other considerably in size, are larger than the subcutaneous tubercles, and are more variable in structure. They have been found of every intermediate magnitude between a small grain of wheat or oat and a large melon.

Dr. Smith, of Dublin, found on the left sciatic nerve of a man who died in the Richmond Hospital, a neuromatous tumor which measured ten inches in its transverse, and eleven inches in its long diameter. The fibres of the nerve were separated from each other, and studded with small oblong tumors.[2]

Neuromata are either round, oblong, oval, or fusiform. They are situated either between the neurilemma and the nerves, or in the connective-tissue between bundles of the nerves. In the former case, the bundles, although pressed together and flattened, are not separated from each other; while in the latter case they are spread out, sometimes in a very regular manner, over the surface of the tumor.

In structure they not unfrequently differ from each other to a very considerable degree. The majority, or those of small and moderate size, are generally solid throughout, although not of uniform density. Sometimes they are exceedingly dense, and have a fibro-cartilaginous and glistening appearance, with a yellowish or grayish tint. They consist for the most part of tough and wavy fibrous tissue, in connection with a variable number of nuclei and small cells. In an interesting case of paralysis of the third cerebral nerve with slow hemiplegia of the same side, from supposed syphilitic disease of the brain, under the care of Dr. Hughlings Jackson, a neuroma of the third nerve, among other lesions, was discovered after death. The description which I gave of the structure of this tumor is applicable generally to neuromata of this kind. "On examination under the microscope, it was found to be everywhere composed of a multitude of nuclei, with some nucleated cells, and an abundance of fibrous tissue. Some of the nuclei were more or less oval, but the majority were round, and measured about the $\frac{1}{3500}$

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[1] Valleix, Traité des Névralgies, p. 563.

[1] Descot, Dissertation sur les Affections locales des Nerfs, p. 245.

[2] Treatise on the Pathology, Diagnosis, and Treatment of Neuroma. 1849, plate ii.

of an inch in diameter. Amongst these were other bodies of the same nature, but of all degrees of smaller size, and either elongated, angular, or in the form of granules. The nucleated *cells* were of very small size, and very granular in structure. A few of them were sparingly scattered through the tissue, but, for the most part, they were collected here and there into small, oval, or circular groups. Between these elementary bodies there was an abundance of ordinary fibrous tissue. The fibres were generally more or less tortuous, but parallel, and in their course each divided again and again into finer filaments, which were connected with the cells and with all the other elementary bodies; the granules and the angular or elongated nuclei filling up the interspaces between those that were oval or round; and thus contributing to form with these and the fibres, a close, uninterrupted, and *reticular* structure."

In other and less numerous kinds of neuroma, the tumor may consist of a single cyst containing a gelatinous fluid, or of a larger mass of ordinary structure containing a number of cysts.[1] Occasionally the tumor has been found to be lobular; the lobules having been connected with branches of the nerve on which the mass was seated, as in a case that will presently be described.

[Neuromata are divided into the true and the false. The *true neuroma* is a neoplasm composed chiefly of nerve-fibres, mixed with connective tissue, and according as nerve-tissue, vessels, or fibrous tissue is predominant, is designated glioneuroma, neuroma teleangiectodes, fibroneuroma, etc. The *false neuromata* consist of fibromata, myxomata, sarcomata, carcinomata, etc. *Fibromata* are, of all neoplasms of nerve, the most frequently encountered. They consist of connective tissue, and have a few nerve-fibres intermingled. They occur as small hard knots on the peripheral nerves, especially on the small cutaneous branches about joints, and are remarkable for the intense pain which attends them, sometimes arising spontaneously and in paroxysms, and again excited by changes in the weather. *Myxomata*, although less common than those just mentioned, are still quite often encountered. They are so named because composed of a soft, gelatinous, and transparent material consisting of branching and intercommunicating stellate cells. This form of tumor also undergoes cystic degeneration, not unfrequently, whence the variety *neuroma cysticum*. The various forms of *sarcomata* occur only rarely in the nerves. They often present a close correspondence in development and in their external characteristics to myxomata. The ordinary varieties of *carcinoma*, also, develop in connection with nerves—either entering them from adjacent parts and extending along the neurilemma, or arising from the nerve-elements themselves.

To these forms of neoplasms should, also, be added *syphilitic gummata*, which usually penetrate the nerves from the cerebral or spinal dura mater. The most frequent site of these gummata is the middle fossa of the skull, the cerebral nerves, originating there or passing through, being invaded.]

Unlike the subcutaneous tubercles, neuromata grow somewhat rapidly, and steadily enlarge, although they are liable to increase and diminish alternately in size. Their number is exceedingly variable. Sometimes they are solitary, one only being found on a nerve-trunk; sometimes several form on the same trunk, or on the same branches of a nerve; and in rarer instances they form on all or nearly all the spinal nerves in the same individual. Dr. Hughes Bennett states, that in the Museum of the Richmond Hospital, Dublin, he examined a most remarkable series of preparations, taken from two individuals in whom almost every nerve of the body presented knotty swellings.[1] In the case already quoted from Dr. Smith, of Dublin, in reference to the enormous neuroma on the sciatic nerve there were also found on the anterior and lateral regions of the right *lower* extremity, no less than 150 tumors, and about 100 on the nerves of the right *upper* extremity.[2] In another case described and figured by Dr. Smith, the abdomen and lower part of the thorax were covered with a vast multitude of small superficial neuromatous tumors, which might easily have been confounded with malignant tubercle.[3]

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John Hunter removed from the musculocutaneous nerve one about the size of a hen's egg, over which the fibres of the nerve were spread out.—Sir E. Home removed from the axilla of a Frenchman a hard oval tumor about three inches and a half long, and two inches broad. It was enclosed between fibres of one of the large nerves of the axillary plexus, and was the cause of terrible suffering.—Louis removed from the forearm of a young lady a tumor which made its appearance fourteen years back, as a small hard substance midway between the bend of the arm and the hand. At the time of the operation it had so much increased in size that it extended over the whole front of the forearm, and was about six inches in diameter in the middle. The pains increased in severity in proportion to its growth. On examination after its removal, it was found to consist of several lobes, which were connected by pedicles to branches of the radial nerves, like grapes to their stalks.[1]

The exciting cause and mode of origin of these tumors are often exceedingly obscure; but not unfrequently they may be traced to external injuries, particularly to blows and contusions. Cases of this description are recorded by Sir C. Bell,[2] Dupuytren,[3] and others.

When the neuroma is superficial, the diagnosis is by no means difficult. In general the tumor is movable laterally, but cannot be moved in the direction of the nerve without causing great pain. In most cases the skin which covers it remains unaltered, but when the tumor is very large the cutaneous vessels, especially the veins, are sometimes dilated.

The only effectual remedy for these morbid growths is the knife. The operation may consist either of excision of the tumor, with or without a portion of the nerve, or of amputation of the affected limb. When the neuroma is very intimately connected with the nerve, and there is reason to believe that it cannot be extricated from the nerve without great disturbance or injury, it is better to remove a portion of the nerve with it. With regard to the sciatic nerve, which supplies the whole of the limb, excision of a portion of its length would be attended with serious consequences, and therefore, unless the tumor be confined to that portion of it which forms the posterior tibial nerve, and the peroneal nerve can be saved, it would probably be advisable to amputate the limb.

Tubercle.—Dupuytren and Cruveilhier have spoken of tubercle in nerves, but there appears to be no evidence to prove that it is ever found in this situation as a primary disease; although nerves are sometimes destroyed by the softening of tubercles in which they are involved.

Cancer, unlike tubercle, is frequently met with in nerves, both as a primary and secondary affection. The form of the cancer is in general either the white medullary, or melanosis. It may occur at any part in the course of a nerve, but it is mostly found near its peripheral extremities. It generally grows to a considerable size, as in medullary cancer of the retina. As a secondary disease it is communicated to the nerve by a contiguous cancerous growth.

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[illegible] on the [illegible] the optic [illegible] nerves.

[illegible] the proper [illegible] existence [illegible] true, as we [illegible] inflamed por- [illegible] con- [illegible] is the [illegible] ex- [illegible] the neuri- [illegible] between its [illegible] supplied [illegible] from [illegible] nutrition, de- [illegible]

[illegible] other gene- [illegible] is found [illegible] protracted [illegible] nutri- [illegible] the result [illegible] viz., chronic [illegible] compression, [illegible] Of these [illegible] caused [illegible] glands, etc. N[illegible] waste after [illegible] organs to w[illegible] nerve after [illegible] the eye. In some instances [illegible] only are implicated [illegible] but the [illegible] the neurilemma [illegible] greater or less degree. During the process of atrophy, the [illegible] their white [illegible] at intervals, and [illegible] their axis-cylinders in masses, which again break up into smaller fragments that are mingled with fatty particles.

INJURIES OF NERVES.

Contusions of nerves are frequently followed very insidiously by the most serious consequences. If the blow be not very severe, the principal change produced in the nerve is the extravasation of blood and other fluids into the connective tissue between its bundles. There are pain, numbness, tingling, or formication in the parts supplied by its branches, followed, in a greater or less degree, by partial and temporary paralysis, and atrophy of the muscles. If the contusion be very violent, the fibres of the nerve may be lacerated or crushed, and then the atrophy and paralysis are of a much more serious character, and may follow the injury either immediately or not till after an interval of weeks or even months.[2] As we have already seen, tumors are liable to form on nerves that have been contused.

Compression and distension of nerves are frequently the results of a great variety of causes. Of these, dislocation of large joints, and the attempts made at reduction, are among the most common. The effects are more serious in proportion to the length of time before the dislocation is reduced. Sensibility suffers much less than the power of motion. If compression of a nerve be severe and long-continued, it may give rise to incurable paralysis and wasting of muscles. When the injury is not so severe, it causes pain of a more or less acute, and more or less constant, character, attended sometimes with a feeling of numbness or tingling. Nerves may be compressed, also, by aneurisms; by tumors of different kinds formed either upon them, or in their immediate neighborhood; by enlarged glands or bursæ; by abscesses; by cancerous growths; by fecal distension of the rectum and sigmoid flexure of the colon; by hemorrhoids and other causes.

Sir B. Brodie relates the interesting case of a man who had severe pain on the inside of his knee. No marks of disease could be detected in the joint, but in the thigh there was an aneurism of the femoral artery. Sir E. Home applied a ligature round the artery in the upper part of the thigh; the tumor immediately ceased to pulsate, and the pain in the knee ceased also.[1]—The remarkable case related by Morgagni of aneurism of the right groin pressing on the sciatic nerve and producing ulceration with intense pain, has been already quoted.—Scarpa also describes an interesting case of aneurism of the abdominal aorta, causing disorganization of the lumbar nerves and injury to the anterior crural and obturator nerves.[2]

Tumors in the immediate neighborhood of nerves are frequently, by the pressure which they exert, the cause of as much suffering as those which are formed upon them.

Sir B. Brodie mentions the case of a gentleman who suffered severe and increasing pain in the left leg, from the foot to the knee, in the course of the peroneal nerve. As the limb presented no morbid appearance, the disease went by the name of neuralgia. After a considerable time the patient died of dropsy, and on opening the abdomen a large solid tumor was found attached to the left side of the lumbar vertebræ. It was evident that this tumor must have pressed on the origin of the sciatic nerve.[1]—Mr. Travers published an interesting case of compression of nerves by a medullary tumor in the ham;[2] and Sir William Lawrence mentions the case of a tumor in the forearm of a gentleman, situated over the course of the ulnar nerve, and causing exquisite pains, like electric shocks, upwards and downwards, in the direction of the nerve.[3]—Mr. Morris has recorded a most remarkable case of ungovernable satyriasis, excited apparently from pressure on the internal pudic nerve made by a tumor that arose from a blow on the perineum.[4]

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[1] Descot, Sur les Affections locales des N[illegible]

[2] Several interesting cases, showing remarkable consequences of contused wounds of the scalp, are recorded by Pouteau, Œuvres posthumes, tome ii.

[1] Works, vol. iii., p. 135.

[2] Treatise on Aneurism, translated by Wishart, p. 99.

Tumors of this description are liable to be mistaken for neuromata, or for those tumors which are formed on nerves or in their substance; but a correct diagnosis may generally be made by moving the tumor in different directions. If the tumor be free, pain will be felt only when it is pressed in the direction of the nerve.

Enlarged glands are not unfrequently the cause of compression and distension of nerves; and there is no nerve so frequently affected in this way as the facial. Several cases of this description were published by Sir Charles Bell.[5]

Sir B. Brodie mentions a case in which "two lymphatic glands, enlarged to the size of large walnuts, were found situated beneath the skin, on the anterior part of the thigh." A considerable branch of the lumbar nerves lay over each of these glands, being thus kept stretched like strings of a violin over its bridge, and giving rise to violent pain and convulsive movements of the leg.[6]

The same author mentions a case of severe neuralgia in the foot, caused by the descent and pressure of internal hemorrhoids, after each evacuation from the bowels.[7]—Romberg calls particular attention to neuralgia of the obturator nerve caused by crural hernia, and gives a long but interesting case in illustration.[8]

Pain of a very acute kind is more often excited by small interstitial growths in nerves than by large tumors over which the nerve-fibres are stretched; for nerves may be stretched to a very considerable extent without exciting any painful sensation, until they become inflamed, or their nutrition be impaired, when the slightest touch causes acute pain. It therefore seems highly probable that the painful effects of compression and distension, by whatever means they may be produced, are in many instances the result of inflammation or of some peculiar kind of irritation which has been excited. When nerves are bruised or otherwise injured at their exit from a foramen or bony canal, they are very liable to cause suffering, because in the event of inflammatory swelling, they are sure to be compressed.

Laceration of nerves occasionally takes place from different kinds of causes, such as accidents by machines, heavy falls, fractures of bones, dislocation of joints and attempts at reducing them. It is somewhat surprising, that, except in parts that are vitally important, laceration of nerves is not followed by serious consequences so often as might be expected.

Béclard has related many cases of this description.[1]—Flaubert mentions a case in which the last four nerves of the brachial plexus were torn from the spinal marrow, by violent extension in attempting to reduce a dislocation of the shoulder-joint. The patient died at the end of eighteen days.[2]—In St. George's Hospital Museum[3] there is a preparation showing the anterior root of one of the cervical nerves torn from the spinal cord, by dislocation of the vertebræ in a heavy fall.

Ligature of nerves.—It sometimes happens that in tying an artery a nerve is accidentally included in the ligature. In certain cases this accident has been followed by severe local and constitutional disturbance, and even by fatal effects. Many instances of tetanus resulting from the same cause, after amputation, have been recorded by several writers. When pain is referred to the amputated limb along the distribution of a particular nerve, there is reason to believe that this nerve has been included in a ligature; and if on pulling at the ligature the pain experienced be aggravated, there can be no longer any doubt as to its cause. Under these circumstances, if tetanus, or any other alarming constitutional disturbance be threatened, the ligature should be immediately removed.

Hennen gives a most interesting account of the effects of ligatures on nerves, in the case of a general officer who suffered amputation of an arm, which was destroyed by a bullet in action. After the occurrence of fever and extensive sloughing, an attempt at clearing the ligatures was attended with the most excruciating pain. "He has," says Dr. Hen-

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[1] Works, vol. iii., p. 135.

[2] Med.-Chir. Trans., vol. xvii., p. 389.

[3] Ibid.

[4] Trans. of Medical Society of London, vol. i., part i., p. 174.

[5] Nervous System, appendix.

[6] Works, vol. iii., p. 139.

[7] Ibid., p. 141.

[8] Romberg, Nervous Diseases of Man, vol. i., p. 75.

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[1] Bèclard, apud Descot, Affections locales des Nerfs, p. 41.

[2] Flaubert, Mémoire sur plusieurs cas de Luxation, etc.; Répert. gén. d'Anat. et de Phys. pathologiques, 1827, vol. iii., part i., p. 102.

[3] Series viii., No. 131.

nen, "frequently, after the smarting of dressing was over, with great accuracy pointed out on my arm the course of the internal cutaneous nerve, as the site of his ideal pain; often he has described that of the external; and on one occasion I, with utter astonishment, had the general neurology of my arm and fingers traced by him. Once only did I ever know him to refer his pain to the sensorium itself. On that occasion, from using an artery forceps to the ligature, on which the slide moved rather stiffly, I exerted a greater force than I intended. He convulsively put his hand to his head, expressed a sense of exquisite pain in his brain, involuntary tears dropped from his eyes, a paralytic contraction momentarily affected his mouth, an universal paleness spread over the uncovered part of his body, and he uttered a piercing cry, exclaiming that the agony of his head and mouth was insufferable. The state of collapse was so great that I was obliged to send an aid-de-camp instantly for volatile alkali and a glass of Madeira, by which he was soon relieved; but the painful sensation and the prostration of his strength continued through the day.[1]

Complete division of nerves.—The effects of complete division, as of other injuries, of nerves, vary considerably in different individuals, according to peculiarity of diathesis, or even in the same individual at different times, according to the state of the general health, and other accidental circumstances. In a healthy person, when the external wound heals kindly by the first intention, no remarkable pain or unusual consequences are experienced. Both portions of the divided nerve retract a little, and their extremities, especially the upper one, enlarge and become more vascular, while coagulable lymph exudes around and between them. In a short time this exudation becomes gradually firmer, and is found to contain cells and nuclei, and then fine nerve-fibres, which proceed from the extremity of the central portion of the nerve to that of the peripheral portion, which, on being separated from its nervous centre, undergoes a gradual atrophy or degeneration. These newly-formed fibres are finer and grayer than those of the central portion of the divided nerve, and it is not till after a period of some months, that they become fully developed. In the mean time a regeneration of fine fibres is going on in the peripheral or atrophied portion of the nerve; but it is a long time before these fibres acquire the normal size and appearance. The same kind of reparative process takes place when a portion of a nerve has been excised, only it occupies a longer period.[2]

When the external wound, instead of healing kindly by the first intention, becomes irritable and inflamed, the ends of the divided nerve participate in the inflammation, and give rise to violent pain, spasmodic contraction of muscles, and other severe symptoms. This is what sometimes occurs after amputation when the stump inflames.

Mr. Langstaff has related an exceedingly interesting and instructive case of this description.[1] After amputation at the forearm in a female, the stump did not unite favorably, and she suffered the most distressing agony, which so affected her health that she became extremely nervous. "There was a constant state of convulsive action of the muscles of the stump. Everything that could be done to improve her health and relieve pain was fairly tried for several months, without the least good effect. She was hysterical, and the paroxysms were frequent." After the stump had healed, a pulsation almost aneurismal could be felt in the situation of the ulnar and radial arteries. Having seen, in several cases, symptoms similar to those caused by the extremities of the nerves becoming ganglionic, and a second operation rendered requisite, Mr. Langstaff removed the arm above the elbow-joint, and previous to securing the arteries, drew out each nerve to the extent of half an inch from the surface of the stump, and cut through them to prevent their interrupting the progress of cicatrization of the integumental parts. The patient was relieved of all her painful sensations, a good stump was made, and her health improved. On examining the amputated part, the median, radial, and ulnar nerves were found remarkably large. The extremities of the two latter were greatly increased by deposition of organized lymph.

Sometimes, after the complete cicatrization of the external wound by which a nerve has been divided, the cicatrix becomes inflamed, and the nerve participating in the inflammation may give rise to the most acute pain, particularly when the part to which it belongs is put in motion. In other cases one or both ends of the divided nerve may be involved in the cicatrix, and be the cause of the most severe suffering. The position of the cicatrix is sometimes important, as when it happens to cross at a right angle the tract of a large nerve which is so related to it as in certain positions of the limb to be pressed against it, causing pain and even loss of motion.

Incomplete division of nerves is, in general, productive of much severer consequences than when the division is complete. If nearly the whole thickness of the nerve be divided, the free portions will retract and put the undivided portion on the stretch; but except in peculiar constitutions, under unfavorable conditions, or when the nerve becomes inflamed, this tension does not in general appear to give rise to serious results. Sir Astley Cooper, in removing a tumor, cut away two-thirds of the thickness of the median nerve. Tingling of the fingers, with some partial numbness, ensued, but nothing more.[1] But partial division of nerves occurring in persons of a peculiarly nervous, irritable, or hysterical constitution, is frequently a cause of the most distressing local and general symptoms.

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[1] Military Surgery, p. 191.

[2] The process by which divided nerves are reunited has been recently investigated by J. Müller, Stricker, Steinrück, Nasse, Günther, Schiff, and especially Vulpian. (Physiologie générale et comparée du Système nerveux, douzième leçon. 1866.)

[1] Medico-Chirurg. Trans., vol. xvi., p. 140.

Punctures made with different kinds of pointed instruments are the most common instances of this species of injury to nerves. The first symptom which ensues is generally acute pain at the injured part, coming on most frequently at the time of the accident, and darting along the course of the nerves either towards their peripheral extremities or in the opposite direction towards the spinal cord and brain. It is sometimes periodical in its attacks, and attended with redness, tingling, or more or less numbness and swelling of the part. Contractions of the limb, violent spasms or tremors of the muscles, trismus, and even epileptiform convulsions, are not uncommon, and in females hysterical excitement is a frequent consequence. After a time, if the symptoms continue severe, the spirits become depressed, there is more or less prostration of strength, and, in some cases, delirium and coma supervene. The pain is often reflected on to other nerves with which the injured nerve is connected only through the nervous centres, and this sympathetic influence is sometimes experienced to a surprising and terrible extent.

Mr. Wardrop has related the case of a woman who pricked the forefinger of her right hand, near the joint, with a gooseberry thorn. The wound was immediately followed by great pain, swelling and redness, which in a few days extended along the forefinger and adjoining phalanx of the middle finger. At the end of three months the pain and swelling disappeared, except from the two first phalanges of the wounded finger, which remained extremely painful. The patient's general health suffered considerably, and she had severe nervous paroxysms two or three times a day, during which the pain extended along the finger to the back of the hand, and between the two bones of the forearm, darted through the elbow-joint, and up the back of the arm to the neck and head, producing a sensation at the roots of the hairs as if they had become erect. To these symptoms succeeded dimness of sight, and subsequently the pain extended to the stomach, producing nausea and vomiting. She had constantly the feeling of a lump in her stomach, and vomited after taking food or drink. At the end of seven months three incisions were made at the point of the finger, but they gave her no relief. She was afterwards completely cured by amputation of the finger.[1]

A case in which the most violent effects arose from the puncture of a nerve during the operation of bleeding, was related to Mr. Swan by Dr. Wilson, of Grantham. The patient, who was a woman, had been bled by a gardener. On the second day she fell into strong convulsions, and some time after became comatose. The median vein in which she was bled had not healed, and was somewhat inflamed. An incision was made just above the orifice of the vein, when the patient immediately cried out, "I am well; I can stir my arm."

Even fatal effects occasionally follow the puncture of a nerve during the operation of bleeding. Such a case is recorded by Bonetus.[2]

Incised wounds of nerves are frequently the cause of the same kind of symptoms as those produced by puncture.

Hamilton relates the interesting case of a girl, aged seventeen, and of nervous temperament, who, while cutting bread, wounded the septum between the thumb and forefinger of the left hand. The pain from the first was very severe, became still more so, and extended to the thumb, forefinger, back of the hand, up the forearm, inside of the arm to the axilla, shoulder, and side of the neck. These and other symptoms continued for nearly three months after the external wound had healed, when she got a fright in the street, and fell into an hysterical fit. After two days of hysterical symptoms, all pain and swelling left the arm and never returned.[3]

This interesting case is a good illustration of the remarkable influence of hysteria in aggravating the effects of local injuries, and affords an example of the singular manner in which these effects are removed by sudden emotions of the mind. Sir B. Brodie, who paid so much attention to this important subject,[4] justly observes, that when the patients are subject to hysterical paroxysms, sometimes the paroxysms cease on the appearance of the local symptoms, and sometimes, on the contrary, a recurrence of the former is followed by an abatement of the latter, or by complete recovery from them.

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[1] Lectures, by Tyrrell, vol. iii., p. 171.

[1] Medico-Chirurg. Trans., vol. viii., p. 246. Sir B. Brodie has described a case of the same kind, occurring in a young lady eleven or twelve years of age (Works, vol. iii., p. 170).

[2] Sepulchretum, tom. ii.

[3] Dub. Med. Journ., vol. xiii., case iii., p. 42.

[4] On Local Nervous Affections, and Local Hysterical Affections, Works, vol. iii.

He mentions the case of a young lady, who, having long suffered from hysterical neuralgia of the hip-joint and thigh, was entirely cured of all her symptoms on being thrown from a donkey.

I knew the case of a girl who, while suffering from complete hysterical paraplegia, jumped up in a fright, on seeing a mouse run across the room, and was cured from that moment.

For an important case of incised injury of nerves of which the following is the substance, we are again indebted to Mr. Wardrop.[1] A young gentleman cut the distal phalanx of the left thumb obliquely across the radial side with a gun-flint. The wound readily healed, but on the patient living freely, in a few days the thumb became painful, and although no change in its appearance could be perceived, and the cicatrix seemed perfectly natural, the pain extended to the forefinger, the radial side of the middle finger, and up the arm as far as the neck and side. The pulse was frequent and tense, the face flushed, and the tongue white and frothy. Copious general bleeding gave almost immediate relief. The symptoms, however, returned and yielded to another bleeding, with copious purging. The paroxysms of pain were several times distinctly produced by mental excitement, and on some occasions were brought on by taking even a small portion of animal food. The wounded thumb, which was at all times painful and extremely tender to the touch, was sometimes seized with paroxysms of agonizing pain, which was no longer confined to those fingers supplied by the radial nerve, but extended over the whole hand, arm, neck, and even down the back. Mr. Wardrop divided the injured nerve, with complete abatement of all the symptoms. The success, however, was not permanent, for during several weeks after the operation, whenever he took food of difficult digestion, when purgatives did not readily operate, or when his mind was at all excited, the pain attacked his hand and arm, sometimes severely. After that time he completely recovered. The point of the thumb, however, always remained numb; but whenever the patient's stomach was disordered, he felt pain in the thumb.

This interesting case has several points worthy of particular observation. It affords a good example of acute inflammation excited in a recently injured nerve by a too early use of the part which it supplies, by an incautious mode of living, or by mental excitement. We also see not only that the pain—or rather the irritation exciting the pain—was reflected from the injured nerve to other and even distant nerves with which it is connected only through the medium of the nervous centres, but that even after the connection of the injured portion of the nerve with its nervous centres had been interrupted, pain was still excited in the other nerves by accidental causes. Indeed, in very severe or long-standing cases of traumatic neuralgia, there is reason to believe that the nervous centres in which the injured nerves are implanted, are sometimes secondarily and permanently deranged or diseased, and in this way become the source not only of neuralgia, but even of paralysis in other and distant parts. Among other cases that might be mentioned, one important case of complete division of a nerve, recorded by Mr. Swan, appears to be of this nature.

A young lady, aged twenty-three, on December 20, 1822, wounded the ulnar side of the second finger of the left hand, near the middle of the second phalanx, while cutting an orange. The pain extended to the centre of the left breast, and up the left side of the neck to the face, along the branches of the facial portion of the seventh(?) nerve. On the sixth day after the accident the wound had entirely healed, but was extremely tender. The pain was excruciating when she attempted to move the arm with the hand in a state of pronation. Whenever she read, pain was produced in the superciliary nerves of the left side, after about five minutes. As the patient's health was suffering, on January 11, 1823, Mr. Swan divided the digital nerve near the middle of the first phalanx. She was immediately and completely relieved, and could move her arm in any direction without pain; but, as the effects of the operation was not permanent, on March 5 the finger was amputated at the joint between the metacarpal bone and the first phalanx, and on examining it at the original wound, a small fibril of the digital nerve was found divided; the end of this next the tip was found incorporated with the cicatrix; the other was formed into a small bulb. At the place of the division of the nerve at the first operation, both its extremities were incorporated with the cicatrix, as were those of the dorsal branch, which had also been divided. Although her local and general symptoms were much relieved by the operation, she continued to feel pain in the hand, arm, neck, and face, and, about four months later (in July), she began to complain of her spine. About the end of November she complained very much of pain in her back, with tingling in her arms, and a difficulty of supporting herself erect. Percussion along the spine produced uneasiness in every part, and much pain about the lower dorsal vertebræ. Some time after, she was seized with violent pain in the left knee, which lasted for two or three days. Pressure on each side of the spinous processes of several of the vertebræ produced pain, and percussion with a key made it very severe. She had difficulty in voiding her urine. In October, 1824, she complained of numbness and loss of sensation in the left hip and shoulder, and of pain at the back of the neck, with a feeling as if the neck could not support the head. At the latter end of the year 1825 and beginning of 1826, she was affected by dizziness, in fits of which she fell down, but never entirely lost her consciousness. Her left arm and leg were weaker than the right. When the membrane lining the left external auditory meatus was touched, cough was produced. Up to March, 1829, she had varying degrees of pain and weakness, soreness in the throat, with an appearance of venous congestion and disorder of the digestive organs, with great tenderness in a spot about the size of half-a-crown at the pit of the stomach. She had also some pain and swelling about the uterus and vagina. When sleeping on her left side she very frequently awoke with pain in the amputated finger. Tic douloureux was brought on by either exciting or depressing emotions, by exposure to strong light, and by fits of sneezing, with which she was frequently troubled. When Mr. Swan last saw her, on October 30, 1833, she was nearly in the same state as she had been in for a long time; but we are left in ignorance of the subsequent course of the disease. The patient's father had a paralytic attack.[1]

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[1] Med.-Chir. Trans., vol. xii., p. 205.

Here, then, we have an instance of very extensive neuralgia, of incomplete but extensive paralysis, and other severe symptoms, extending through a period of ten years, as the effects of simple division of a nerve of one of the fingers. That these morbid symptoms arose out of some peculiarity of constitution, there can be no doubt; and it seems highly probable that this peculiarity was of an hysterical character.

Foreign bodies imbedded in a nerve or pressing against it are often the exciting cause of violent pains and other symptoms similar to those which result from wounds.

Jeffries relates the case of a girl who suffered from violent and almost continual neuralgia of the face for fourteen years. A hard, pointed substance was felt under the skin of the right cheek, and at this point the slightest touch brought on an attack of pain. An incision was made, and a triangular piece of a china cup removed, with complete cessation of the neuralgia.

One of the most interesting and remarkable cases of this description is related by Denmark.[2] A young soldier was wounded by a musket-ball, which entered the triceps extensor cubiti, about one inch and a half above the inner condyle of the os humeri, grazing the inner side of that bone, and passed obliquely downward through the brachialis internus, and out anteriorly through the bend of the arm. The wound soon healed without exciting any particular morbid symptoms. The man was subsequently admitted into Haslar Hospital, with excessive pain, frightful dreams, and startings. The forearm was always bent and in the supine posture. A small tumor could be felt in the site of the wound on the anterior part of the arm, which he could not bear to be touched. The pain began at the extremities of the thumb and all the fingers except the little one, and extended up the arm to the part wounded. It was a burning pain, and so violent as to cause a continual perspiration from the face. Neither opium nor any other means employed assuaged his intense sufferings. At his own request, the arm was amputated, with immediate relief, and he was discharged cured in three weeks. On examining the amputated arm, the radial nerve seemed to be blended with, and intimately attached to, the wounded parts for the space of an inch. It had itself been wounded, and, at the place of the injury, was thickened to twice its natural diameter, and seemed as if contracted in its length. On further examination, Dr. Denmark was surprised to find, on dividing the fibres on the posterior part of the wounded nerve, that there was a small portion of the ball firmly imbedded in it, which had been driven off by grazing the bone.

Treatment of injuries of nerves.—When an incised or other open wound is accompanied and followed by very acute pain, by more or less numbness, and by partial or complete loss of sensation and motion in the part beyond the wound, we may conclude that a nerve has been either injured or divided. Under these circumstances it is of primary importance to remove all dirt or other foreign bodies that may be present, to promote healing by the first intention, and to enjoin perfect rest. If these precautions are not adopted, and the external wound inflames, the nerve is liable to participate in the inflammation, and may then become the source of the violent and distressing symptoms already described. When this is the case it may be necessary to apply leeches to the neighborhood of the wound, to use either cold lotions or warm fomentations of poppies, and poultices, and to act briskly on the bowels by means of purgatives. When the inflammatory symptoms run high and the constitutional disturbance is considerable, I have seen the most decided benefit derived from a combination of tartarized antimony, opium, and hyoscyamus, given at short intervals, the antimony being in sufficient quantity to keep up a state of great nausea.

In some cases, after all inflammatory action has subsided and the external wound has completely healed, painful and distressing symptoms may still persist at intervals for a very considerable period;

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[1] Swan, Diseases, etc., of Nerves, 2d edit., p. 129. Of this remarkable case I have given the briefest possible abstract of the most salient and important points, but the details, which are very full, deserve attention.

[2] Med.-Chirurg. Trans., vol. iv., p. 48.

and in other cases where the external wound has healed at once in the kindliest manner by the first intention, similar symptoms may supervene. Most of these latter cases are females of a more or less hysterical constitution. But, as we have already seen, there are other causes besides hysteria, such as pressure, dragging, or inflammation of a cicatrix; a premature use of the limb—that is, before the nerve is sufficiently repaired or united; and while the nerve is in this state, it is in some cases very susceptible of irritation by errors in diet, intemperate habits, mental emotions and influences of the most trivial nature. One part of the treatment will of course consist in avoiding or removing the exciting cause, if this can be ascertained. When the cicatrix presses on the nerve, active frictions with moderate exercise of the part will relieve the pain. If it be simply painful or tender, the application of belladonna will frequently allay the irritation; or if it appears to be inflamed, the removal of a little blood by means of two or three leeches may be necessary. If pain and tenderness be experienced in the course of the nerve, repeated leeching, or blistering, and sometimes actual cautery will afford relief. In cases of that intense *burning* pain which is sometimes so agonizing in nerve-wounds, there is no treatment so successful as repeated blistering. The painful state of the parts to which the wounded nerve is distributed may be treated by the local application of anodynes, such as chloroform, aconite, opium, and belladonna; and the most effectual mode of using the two latter substances is by subcutaneous injection. Mr. Pearson[1] has recorded a very remarkable case of neuralgia, which, after resisting every kind of treatment, yielded at length to the application of a stimulating embrocation that was rubbed into the part for ten minutes twice or three times a day.[2]

In some instances when every other remedy has failed, the happiest effects have resulted from the use of mercury exhibited for a period sufficiently long to affect the gums. Mr. Hamilton has recorded two cases of this description.[3] In many instances, however, in which this remedy has been employed, it has completely failed.

In extreme cases, when all other resources are exhausted, it becomes a question whether the nerve should be divided or a portion of it excised, or whether the member which it supplies should be amputated. If the constitutional disturbance be of an alarming character, there should be no hesitation in at once dividing the nerve, or excising a small portion; for these operations have been frequently followed by an immediate arrest of all the symptoms, as in Dr. Wilson's case already mentioned.[1]

In a case of contused thumb followed by violent symptoms, Sir Astley Cooper removed five-eighths of an inch of the radial nerve with complete success.—Mr. Sherwin relates the case of a servant-maid who suffered from the most alarming symptoms after the operation of venesection. At the end of a fortnight she was cured by a deep incision above the cicatrix.[2]—A similar case with the same result is recorded by Dr. Watson.[3] Mr. Earle excised about half an inch of the radial nerve for punctured wound of the thumb followed by pain, spasm, temporary trismus, etc., which had lasted for two months. The patient was soon relieved, and after some months completely cured.

In many instances in which division of the nerve has failed, amputation has been performed with complete success, as in the case of Mr. Wardrop.[4] A still more decided example is recorded by Mr. George Bell.[5] A lady, twenty-six years of age, while cutting a loaf of bread, injured the nerve of the thumb on the radial side. The wound healed kindly, but was followed by excruciating pain and other violent symptoms. Two years after, on two different occasions, an incision was made through the soft parts to the bone, in the neighborhood of the wound, but with only temporary relief. Mr. Bell removed the thumb at the second joint, and in five or six weeks she was restored to perfect health.

However, in some cases, especially of females of marked hysterical constitution, neither the division of nerves nor amputation is of any permanent benefit; while in others which have resisted every kind of treatment except by operation, a spontaneous cure has occasionally been effected.

When nerves have been contused or compressed, without becoming inflamed, the best kind of treatment consists of the repeated use of exceedingly hot fomentations, frictions with stimulating embrocations, and faradization. But if tenderness and pain be felt in the course of the injured portion of the nerve, it will be necessary to apply leeches, cold lotions, and blisters, and to insist on perfect rest.

[The treatment of injuries of nerves includes the measures necessary for the relief of the nerve injured, and the immediate and remote consequences of the injury. For the inflammatory action, involving nerves, there is no treatment more effective than the hypodermatic injection of morphia and atropia, or the stomachal administration of quinia and morphia. If the febrile reaction is at all pronounced, tincture of aconite may be administered with advantage. Blistering along the trajectory of the nerve, and the application of morphia to the blistered surface, is highly serviceable after the more acute symptoms have subsided. To these remedies may be added inunctions of oleate of mercury and morphia, ointment of aconitia, etc. There can now be no possible doubt in regard to the power of galvanism to relieve pain, to lessen inflammatory action, and to cause absorption of the products of inflammation, in parts superficially placed. In cases of nerve-inflammation, so situated as to be readily reached by the current, the pain and spasm are relieved by descending stabile applications of moderate current-strength in recent cases, and of strong currents in old cases. Even more important are the applications of electricity in the treatment of the degenerative changes occurring in muscles in cases of disease of motor nerves. For the condition of spasm and rigidity of muscles, the continuous, or descending stabile current, for wasting and paralysis, the interrupted galvanic or faradic currents are required. For the condition known as the "reactions of degeneration" the form of current used is determined by the power of response possessed by the muscles.]

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[1] Medico-Chirurg. Trans., vol. viii., p. 252.

[2] ℞ Ol. olivæ, ℥ijss; terebinth., ℥jss; acid. sulph., ʒjss. M.

[3] Dublin Medical Journal, vol. xiii., pp. 41, 48.

[1] See p. 411.

[2] Duncan's Medical Commentaries, vol. iv.

[3] Medical Communications, vol. ii., p. 251.

[4] See p. 411.

[5] Edinburgh Journal of Medical Science.

NEURALGIA.

It has been already seen that a large proportion of neuralgic cases are due to traumatic irritation or inflammation; that some are the result of idiopathic inflammation, in either an acute or chronic form; that others are the consequence of ulceration; of compression and irritation caused by aneurisms, by enlarged glands, by tumors, etc., either in the neighborhood of nerves or in their substance. Moreover, neuralgia of the trifacial nerve has in some cases been found to depend on disease of the bones of the head and face. In the case of the late Dr. Pemberton, the frontal bone was thickened, and in the falx cerebri there was an osseous concretion.[1] Sir H. Halford found hypertrophy and other morbid states of the cranial and facial bones, such as exfoliations of the antrum, considerable thickening of the frontal, ethmoid, and sphenoid bones. Dr. Bright relates an interesting case of facial neuralgia in which he found fungoid tumors of the brain and disease of the cranial bones.[1] In some instances the disease of the bone is the result of syphilis, which also attacks the nerves themselves, not only in the head but in all other parts of the body.

Many cases of neuralgia have a gouty or rheumatic origin; but there are others that do not depend on any of the causes above mentioned, and in which, when there has been an opportunity of post-mortem examination, no appreciable alteration has been discovered in the nerves. Yet that some peculiar, but perhaps only periodical, change takes place in the tissue either of the nerve itself or of the nervous centre from which it arises, there can be no question; for to speak of functional disorder without some material change, is to speak of an effect without a cause. In some instances, the exciting cause appears to act directly and immediately on the nerve-tissue, as in cases of neuralgia resulting from atmospheric changes, particularly from electric states of the atmosphere. In other instances, the effect may be produced through the medium of the circulation, by malaria and blood-poisoning of different kinds. Anæmia, again, especially in females, is among the most common causes of neuralgia; as is also hysteria, even when unattended by anæmia. Disorders of digestion, constipation, the sudden suppression of secretions, or of habitual hemorrhages, such as hemorrhoids, the catamenia, etc., may all be productive of neuralgia in persons already predisposed.

The points of diagnosis between this form of neuralgia and that which arises from neuritis or inflammation of nerves, are very important, because the treatment required is very different in the two kinds of cases. In non-inflammatory neuralgia, although the pain may be excited or aggravated by the slightest touch, it is generally relieved by firm pressure, which is not the case in neuritis. Moreover, the pain is always interrupted by remissions of variable length in different cases, and is extremely varied in its character. It begins and ceases suddenly, and is apt to shift from one branch of a nerve to another, with a rapidity and intensity which are never experienced in neuritis. Antiphlogistic treatment, which relieves the latter, frequently aggravates non-inflammatory neuralgia.

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[1] Travers, A Further Inquiry concerning Constitutional Irritation, and the Pathology of the Nervous System, p. 351. 1835.

[1] Reports of Medical Cases, p. 506.

NUTRITIVE AND OTHER CHANGES RESULTING FROM INJURIES AND DISEASES OF NERVES.

(1) *Changes due to Injuries of Nerves.*

In the earlier part of the present century a few observers occasionally and incidentally noticed the morbid effects of injuries of nerves on the nutrition of certain tissues; but it is only within the last ten or twelve years that the subject has been systematically studied. These lesions of nutrition consist chiefly of,—

(*a*) Diminution of temperature in the parts to which the injured nerve is distributed.

(*b*) Cutaneous eruptions, ulcerations, and alterations in the color and texture of the skin, and its appendages.

(*c*) Increase or diminution, and alterations in the quality, of its secretions.

(*d*) Periodical swelling of joints and other parts of a member.

(*e*) Atrophy and contractions of muscles supplied by the injured nerve, with distortion and stiffness of joints.

(*a*) The effect of injuries of nerves and of nerve-centres on the temperature of paralyzed parts was well investigated in the early part of this century by several English observers, particularly by Earle and Yelloly.

Earle excised a portion of the ulnar nerve of a girl for severe neuralgia, and five years after he found the temperature of the paralyzed parts decidedly diminished. He also found that they were unable to resist the injurious effects of cold. Frosty weather produced blistering and ulceration of the little finger.[1]—Yelloly mentions a case of anæsthesia, in which similar effects were produced by warmth.[2]

Mr. Jonathan Hutchinson, in a valuable and interesting article on "Injuries to Nerve-trunks,"[3] observes that the parts paralyzed by division of the nerve which supplied them, could never, even in the warmest temperature, be raised to that of adjacent, unparalyzed parts. "Nor does even the existence of active inflammation raise the part to the normal standard, although it much increases it." "It would appear, therefore, that while a paralyzed part can be cooled to almost any extent, it cannot be raised by artificial heat beyond a certain point, and that point much below the maximum of its uninjured counterpart."

(*b*) Romberg, more than thirty years ago, very clearly described some of the most important nutritive changes that the skin and its appendages undergo, when deprived of the proper supply of nerve-influence. There is found, he observes, an increased branny or scaly desquamation of the epidermis, accompanied by an absence of transpiration. The nails curve in, they become rough and ragged, and fall off.

He mentions a case of Dieffenbach's, in which there had been violent pain for ten years in the right foot. On the outer and posterior side of the thigh, near its middle, there was a tumor about five inches in circumference, which was also painful, and, when pressed, augmented the pain in the foot. The tumor was removed in 1836, and Romberg saw the patient two weeks after. There was complete anæsthesia in the parts supplied by the peroneus and tibialis nerves. The muscles of the leg and foot were paralyzed. Ulceration appeared early in the heel. Soon after, the nails exfoliated. At the end of three years, Romberg saw the patient again. She rested on the external edge of the right foot, which thus presented the appearance of varus. Further ulceration ensued, with necrosed bone, and desquamation of the epidermis, like psoriasis, the color of the skin being dark red and shining.[1]—Hamilton relates a case of Mr. Crampton's, in which puncture of the musculo-cutaneous nerve during the operation of bloodletting, was followed by the most severe neuralgia and other symptoms, and the wounded arm became *covered with hair.*[2]—Larrey mentions the case of a soldier who received a kick from a horse over the right eyebrow. The frontal sinus was fractured, and after some days, cutaneous hyperæsthesia and tetanic symptoms of the same side supervened. To Larrey's great surprise, the hair and moustaches of the injured side bristled up and became exquisitely tender to the slightest touch. About a year later the nails became ragged and rough, and fell off.[3]—Similar effects were observed by Bellengeri from a contused wound above the supra-orbital foramen. The hair on the injured side not only became stiffer, but grew with much greater rapidity.[4]—Pouteau records a remarkably interesting case, with symptoms similar to those of Larrey and Bellengeri, and resulting from a contused wound of the supra-orbital nerve.[5]—In a young lady, who came to me with protracted neuralgia of a circumscribed portion of the scalp, the hair over the painful part was not only coarser and stiffer, but perfectly white. Reading, or playing the piano for a few minutes only, brought on the most insupportable and indescribable feel-

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[1] Med.-Chir. Trans., vol. vii., p. 175.

[2] Ibid., vol. iii., p. 90.

[3] London Hospital Reports, vol. iii., p. 321.

[1] Romberg, Nervous Diseases of Man, vol. i., p. 205.

[2] Dublin Med. Journal, 1838, vol. xiii., p. 46.

[3] Clin. Chirurg., tome i., p. 200.

[4] Archiv. Gén. de Méd., 1835, tome vii.

[5] Œuvres posthumes, tome ii., p. 92, obs. iii.

ings, radiating as it were from the affected part.—In a case of temporal neuralgia mentioned by Trousseau, the hair on the affected side turned white, and acquired considerable stiffness in a very short time.

With regard to cutaneous eruptions resulting from injuries, numerous interesting observations, besides the one already quoted from Romberg, have been recorded by Rayer,[1] Earle[2], Rouget,[3] Oppolzer,[4] Charcot,[5] Raynaud,[6], Ruhl,[7], Thomas,[8], Paget,[9] Brodie,[10] and others. These cutaneous affections have been shown to consist chiefly of erythema, and of vesicular eruptions allied to eczema, erysipelas, and herpes. Mr. Paget has given an excellent description of the erythema observed in cases of injured nerves. "In well-marked cases," he says, "the fingers which are affected are usually tapering, smooth, hairless, almost void of wrinkles, glossy, pink or ruddy, or blotched as if with permanent chilblains. They are commonly also very painful, especially on motion, and pain often extends from them up the arm."

It is to Drs. Mitchell, Morehouse, and Keen, of the United States, that we owe the most precise account of the different morbid changes in the skin, and other tissues, resulting from particular injuries of nerves.[11] They have shown that the changes in the skin which follow wounds of nerve-trunks are of two kinds. The first is the result of *entire* division of the nerves of the part, with palsy of the whole limb. In most instances there is early œdema of the part. The skin thickens and dries; the epithelium hangs in patches here and there, and is yellow and even pale-brown. These peculiarities, however, are partly the consequence of mere disuse. But the nails become curved as in tubercular disease.

The second kind of pathological change is the result of only partial division of the nerve. The skin is deep red or mottled, or red and pale in patches. The cuticle seems partially lost, so that the cutis is exposed in places. The sub-cuticular tissues are nearly always shrunken. The surface of all the affected parts is glossy, generally devoid of wrinkles, and perfectly free from hair. Sometimes the fingers are dotted with islets of thin and red and glossy skin. This glossy appearance of the skin is always accompanied by pain, generally of a burning character.[1] "No particular time can be named as the period at which these changes in nutrition first show themselves. This alone can be said, that they do not belong to cases of complete destruction of the nerves. They may begin within a few days, or at any later date; but usually they arise while the wound is healing."

If the nerves of the hand be injured, the hair, after some months, disappears from the affected fingers, and the nails undergo remarkable alterations. These alterations consist of a curve in their long axes, an extreme lateral arching, and sometimes a thickening of the cutis beneath their extremities. In other instances the skin at that end of the nail next the third finger-joint becomes retracted, leaving the sensitive matrix partly exposed. At the same time the upper line of union of skin and nail retracts into or under the latter part, and in place of a smooth edge is seen through the nail as a ragged and notched border. "No deformity of the nails in tubercle at all approaches that which nerve-wounds occasion. Indeed, we think it would be possible for one familiar with these cases to diagnose the existence of nerve-lesion from the form of these protuberant and oddly-curved nails." When the nails of the toes have been attacked, the curving is as marked, but a distressing ulceration is apt to occur at their angles, and to break out again and again. The best remedy then is excision of the outer edge of the nail, matrix and all.[2]

In a case mentioned by Mr. Jonathan Hutchinson of division of the ulnar nerve, the nail of the little finger, about two months after the accident, came off, together with the skin, "like the end of a glove." It grew again, but not to more than half its original size.[3]

(*c*) *Alteration of secretions after injury of nerves.*—We have already seen that after the nerves of a limb have been completely divided, the skin is generally dry: but injuries of nerves without complete section modify the secretions in regard both to quality and quantity. The secretion is generally abundant, and sometimes intensely acid, so that an odor like vinegar can be smelt in the neighborhood of the patient. In one instance the odor of the

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[1] Traité des Maladies de la Peau, 1822, tome ii.

[2] Medico-Chirurg. Trans., vol. vii.

[3] Journal de Physiologie, 1859.

[4] Allgemeine Wiener medizinische Zeitung, No. 48, Nov., 1866.

[5] Journal de Physiologie, 1859.

[6] Thèse de Paris, 1862.

[7] Apud Samuel, Die trophischen Nerven, p. 189.

[8] Archiv der Heilkunde, 1866, p. 153.

[9] Medical Times and Gazette, 1864.

[10] Works, vol. iii., Local Nervous Affections.

[11] Gunshot Wounds and other Injuries of Nerves. Philadelphia, 1864.

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[1] Page 80. Injuries of Nerves, op. cit.

[2] Page 82. Injuries of Nerves, op. cit.

[3] London Hospital Reports, vol. iii., p. 308.

sweat was "disgustingly heavy," and resembled the smell from a bad drain.[1]

(*d*) *Periodical swelling of joints, etc.*—This peculiar affection, which is particularly interesting to the surgeon, is the result of both idiopathic neuritis and traumatic affections of nerves. It so closely resembles ordinary rheumatism or gout that it is not easy to point out the distinguishing characters of the two kinds of disease. Remak calls it *arthritis spuria.*[2] Dr. Mitchell has recorded some very interesting cases of this affection in the American Journal of the Medical Sciences (1869, vol. lviii.). It may occur at any time after the first few days of injury to a nerve, and may attack any articulation, or all the articulations of a member. Once fully established, it keeps the joints stiff and sore for weeks or months. When the acute stage is past, the tissues about the articulations become hard, and partial anchylosis results. Of all the agencies which impede movement, it is the most difficult to relieve.

(*e*) *Atrophy and contraction of muscles from injury of nerves* has been for many years carefully investigated by Dr. Duchenne (de Boulogne), whose work (Électrisation localisée) contains a number of the most valuable cases. Complete division of a nerve is always followed to a certain extent, in the course of time, by atrophy of all the muscles to which that nerve is distributed; and the wasting is much more rapid when the main artery has been divided or interrupted. But in *partial* division or injury of the nerve, only those muscles are liable to suffer which are supplied by the injured fibres, and in this case the wasting is more rapid and decided than when the nerve has been *completely* divided. Thus, a whole group of muscles may be affected, or only part of a group; a single muscle only, or even only part of a muscle, which, moreover, may be affected in either a lateral or a longitudinal direction. So soon as the muscular fibres begin to suffer in nutrition, their tension or tonicity diminishes, they become softer, more flabby, or relaxed. Sooner or later they begin to waste, and after a time, in many instances, they acquire a kind of morbid tension, and contract or shorten permanently to a greater or less extent, causing a variety of deformities, alterations in the form of the joints, and loss of natural movement. This morbid tension, however, is not always in proportion to the degree of atrophy, for in some instances the wasting is slight while the muscular contraction is extreme. Moreover, a muscle may become shortened from paralysis of its opponent, and this condition must be distinguished from the shortening which is due to atrophy.

Early loss of tone in a muscle, from injury of its nerves, is a bad sign. Rapid diminution, of size and contraction, when due to nutritive changes, is still worse. All these changes are ominous of ultimate deformities and permanent loss of power.[1] In the diagnosis and prognosis, no less than in the treatment of injuries to nerves and their consequences, electricity plays a most important part; and for its first application to these purposes, we are chiefly indebted to the remarkable sagacity and skill of Dr. Duchenne (de Boulogne).[2] The way in which he has made it an instrument of diagnosis and prognosis, in diseases and injuries of nerves, is no less important than beautiful in a practical point of view.

[Important advances have been made in electrical diagnosis and therapeutics, since the appearance of Duchenne's Électrisation localisée. The changes, qualitative and quantitative, in the electrical condition of nerves and muscles, have been designated by Erb, "the reactions of degeneration." It is necessary to distinguish between nerve- and muscle-reactions, yet the same electrical energy applied directly to the muscle, or to the motor nerve innervating it, causes contractions. Hence, it follows, we have in the muscular movements also a means of ascertaining the condition of the motor nerve.

When a motor nerve is injured and inflamed, without being completely divided or destroyed, there is a brief period during which the electro-contractility of the muscles innervated by it, is heightened; that is, to a less stimulation than in health, the muscles readily contract.

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[1] Mitchell, Morehouse, and Keen, op. cit., p. 86.

[2] Allg. med. cent. Zeitung, Berlin, 1863. Ueber den Einfluss des Nervensystems auf Krankheiten der Knochen und der Gelenken.

[1] Mitchell, Morehouse, and Keen, supra, p. 120.

[2] The following statement is made by the most competent judges on this subject. "As respects its value in traumatic lesions of nerves, we feel constrained to state that it has been understood and rightly appreciated by Dr. Duchenne alone. After a year of great experience in the use of electricity, we are still satisfied of the essential correctness of almost every proposition on the subject which this distinguished physician had laid down." (Mitchell, Morehouse, and Keen, op. cit., p. 136.) I am glad to learn from Dr. Duchenne, that a somewhat abridged English translation of his laborious work is in course of preparation. It ought to be in the hands of every surgeon and physician. No one, judging from its unhappy title alone, would expect to find in it so rich a mine of pathological facts.

This heightened electro-contractility corresponds to a period of excitation of the nerve elements, coincident in point of time with the stage of congestion of the inflammatory process. If the inflammation continues and is destructive, softening and disintegration of the nerve-elements occur, and from the second or third day a quantitative decline in the electric excitability of the inflamed nerve takes place. If the injury done is irreparable, or if the inflammation destroys the nerve-elements, this quantitative decline continues, so that by the twelfth day, sometimes earlier, the electric excitability entirely disappears. This change in the electrical reactions of the diseased nerve, begins at the point of injury and spreads thence to the periphery. If the injury or inflammation is less severe and destructive, and the nerve-elements remain in part unimpaired, the electric excitability will not be entirely extinguished, and with the final restoration of the nerve-elements, will return the normal electrical reactions. In the course of recovery of the nerve, the power of response to the will is restored before the galvanic or faradic excitability is recovered. In other words, the muscles react to voluntary impulses, under these circumstances, when the strongest galvanic and faradic currents will not excite a tremor.

The muscular reactions are different. In the case of inflammation or injury of the motor nerves, the muscles exhibit the reactions of degeneration. In the mildest cases, there may be merely a quantitative decline in the faradic reactions, but in a typical case, in a few days (by the end of the first week) a decline, and then loss of the excitability to the faradic current takes place, but at the same time the response to the galvanic current becomes abnormally ready, and a less strength of current than suffices to move the muscles in health will produce strong contractions. If the destructive changes proceed, and the muscles degenerate so that their contractile elements are entirely destroyed, then a stage is finally reached when any strength of the galvanic current will produce no movements. The reactions to the electric current thus become exceedingly important in determining the condition of the nerve and muscles. If the injury only suffices to cause a quantitative decline in the response of the muscles to the faradic current, the injury or disease is by no means so important as in those cases in which even the strongest faradic current causes no movement, but a great readiness of contraction on the application of a weak galvanic current has developed. The case is still more serious, when no strength of galvanic current will cause a response on the part of the muscles.

The statement in the original text that the differentiation between cerebral and spinal paralysis was, in part, made by the loss of faradic excitability in the latter, and its preservation in the former, is true to a limited extent only, and requires some further explanation. In hemiplegia, which we may take for illustration of a cerebral paralysis, the faradic excitability may be heightened, may be merely normal, or may be reduced. The decline in the excitability, chiefly quantitative, is due to secondary changes in the muscles. In spinal paralysis the faradic excitability may be present, may be lessened quantitatively, and qualitatively, or may be entirely wanting. The faradic excitability is normal in those cases in which the spinal cord is healthy at that point from which the nerves come off to the paralyzed parts, and is lost in the opposite condition. For example, in a case of transverse myelitis, with paraplegia, occurring in a part of the cord entirely above the dorso-lumbar enlargement, from which the nerves are given off to the inferior extremities, the faradic excitability will be normal; but if the dorso-lumbar enlargement is diseased in its entirety, or in the motor columns, there will ensue loss of the faradic excitability, and the phenomena of the reaction of degeneration will develop. In the "myopathies of spinal origin"—infantile paralysis, progressive muscular atrophy, etc.,—the same symptoms appear: with paralysis occur loss of faradic excitability, and an abnormal readiness of response to the galvanic current. In these, as in the preceding examples, the loss of faradic excitability occurs in the muscular groups, innervated by nerves coming from a diseased portion of the cord. There are maladies of the spinal cord, however, which seem paradoxical in respect to the electrical reactions. For example, in disseminated sclerosis, some muscular groups of one extremity will have lost, and other muscular groups will have retained their excitability to the faradic current. Such a state illustrates, if rightly interpreted, the law above expressed: those muscles receiving their innervation from a healthy portion of the cord preserve the normal reactions, and those communicating with a diseased tract, present the reactions of disease.

Certain terms and formulæ are now used to express the changes in the reactions of nerves and muscles. The normal reactions are taken as the standard. The nerves, as we have seen, are affected equally by the galvanic and faradic currents, but different formulæ are required to express the behavior of muscles when stimulated by either current. In the normal, the weakest galvanic current producing a muscular contraction, is the cathodal closing (C C). With a strong current, there are decided anodal opening and closing contractions (A O C and A C C), and with the cathodal closing, tetanic contractions (C C C). When the reactions of degeneration occur, it should be borne in mind, as has been stated, that there occurs a progressive decline in the power of the paralyzed muscles to respond to the faradic current. This decline in the *faradic* irritability takes place near the end of the first week, and during the second week ends in complete loss. The galvanic irritability exhibits characteristic alterations. During the first week of the paralysis, the power of response of the muscles to the galvanic current declines with the faradic, but in the course of the second week, a very great increase of the excitability of the muscles to the galvanic current is developed. This augmented excitability increases subsequently, and is accompanied by qualitative changes in the order and manner of muscular contraction. As has been before stated, so excitable have become the muscles to the galvanic current, that a strength of current inadequate to cause muscular contractions in health, now induces active movements, but the contractions, instead of being almost instantaneous, are slow and prolonged. With the increase in excitability, there ensues also a qualitative change in the law of muscular contraction above expressed. This change consists in a decided increase in the anodal closing contraction, so that it soon equals, even surpasses, the cathodal. At the same time the cathodal opening contraction increases more than the anodal opening contraction, and soon equals, then exceeds it. After six or eight weeks, or longer, a gradual diminution in the galvanic excitability takes place, but the inversion of the normal formula just described, persists. Gradually, stronger and stronger currents are required to produce contractions, and if the muscular atrophy persists, when the contractile elements finally disappear, no strength of current will produce any response. Persisting in the abnormal law of contraction, the last indication of the presence of any contractile elements is the occurrence of an extremely feeble anodal closing contraction. When the spinal injury or disease is remediable, the excess in the galvanic excitability of the muscles lessens, and presently the muscles react again to the faradic current. Duchenne has made the important observation, that in some cases, notwithstanding the failure of the muscles to respond to the faradic current, persistent applications have at length caused contractions.

In the treatment of the spinal paralyses, the galvanic current must be employed to exercise the paralyzed muscles, until the power of response to the faradic current is restored, when it may be used to complete the cure. If neither current will induce contractions, the case may be regarded as hopeless, for this absence of response indicates the final disappearance of the muscular elements. The faintest response to galvanism gives rise to hope, since a persevering exercise of the undestroyed filaments will sometimes accomplish great results in very unpromising cases.]

When a healthy muscle is made to contract by means of electricity, it becomes the seat of a peculiar pain, which is called electro-muscular *sensibility*. This pain, however, is not caused by the contraction, for it is still experienced in muscles which have lost the power of contracting under the influence of electricity. The property of contracting under the same influence, is called electro-muscular *contractility*. Now it has been laid down by Dr. Duchenne as a law which is very remarkable, but which subsequent experience has fully confirmed, that the persistence of this property of electro-muscular contractility is not necessary for the exercise of *voluntary* contraction.[1] On the other hand, muscles that are partially or completely paralyzed, with regard to the *will*, may sometimes retain their normal degree of electro-muscular contractility; while in certain cases, muscles which have lost, to a very unequal degree, the power of contracting under the stimulus of electricity, may seem to be all equally paralyzed as regards the *will*. There is another remarkable and important practical point to be remembered, viz., that although the retention of electro-muscular contractility is not necessary for the exercise of voluntary contraction, yet that whenever it is lost, or even impaired, the prognosis is unfavorable in reference to the return of *voluntary* control, and indicates that the affected muscles will suffer in their nutrition and become atrophied. It is curious, however, and very important, that notwithstanding the loss of electro-muscular contractility, the *therapeutical* power of faradization may still exercise its influence on the paralyzed muscles. If electro-muscular sensibility be retained, the chances of recovery are more favorable; and whenever it is impaired, if pain be excited by the action of electricity, the effect is a favorable sign.

Different forms of paralysis which depend on traumatic affections of nerves, and which may appear to be exactly alike—which cannot, indeed, be distinguished from each other by the ordinary modes of diagnosis — may nevertheless differ essentially from each other with regard to their progress, their gravity, or their termination. The electro-muscular test alone enables us to discriminate those cases in which muscles will remain paralyzed and become atrophied in the course of a few months, from other cases in which it may be predicted with certainty that the paralysis, without atrophy of the muscles, will disappear, either spontaneously or by means of faradization.

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[1] De l'Électrisation localisée, 2^{me} éd., p. 330.

A man, under the care of the late eminent surgeon M. Roux, at the Hôtel Dieu, had dislocation of the humerus forward. The reduction was deferred till the next morning, when it was found that the head of the bone had changed its place to the axilla. The muscles of the arm, forearm, and hand were completely paralyzed to the will, but sensibility was retained. This state of things having continued for nearly a month, with gradual wasting of the muscles, Dr. Duchenne was requested by M. Roux to examine the arm by means of faradization. All the movements of the upper extremity were found to be completely abolished, and it would therefore have been natural to conclude that all its muscles were equally affected, or rather that all the nerve-fibres that supplied them were equally injured. But it was found that some of the muscles had completely lost their electro-muscular contractility, and subsequently wasted rapidly; while the other paralyzed muscles, which had not suffered in this way, not only escaped atrophy, but recovered their voluntary power after a few applications of electricity. The deltoid had partially lost its electro-muscular power, and therefore required for its restoration a little longer time than those which wholly retained it.

In paralysis resulting from *cerebral* disease, the electro-muscular contractility remains unaffected, and therefore faradization is of great importance in the differential diagnosis of paralysis which follows injuries of nerves or affections of the spinal cord.

A man was admitted into the Hôpital de la Clinique, for paralysis of the right arm. According to his own account, some days before his admission he woke in the morning with his arm paralyzed, but perfectly free from pain. At first he only felt formication in the fingers, with a sensation of numbness and coldness in the whole limb; but a few days after, he began to experience a lancinating and intermitting pain of no great intensity in the right cervical region. The suddenness of the attack, without any preceding pain, occurring in a young man who had not suffered from any traumatic lesion of nerves, or been apparently exposed to any other influence that might occasion paralysis of the arm, would reasonably suggest a cerebral cause. But on examining the limb by means of faradization, it was found that the majority of the muscles had lost, in a greater or less degree, their property of contracting under the stimulus of electricity—a property which, as already stated, is retained in paralysis resulting from cerebral causes. Judging from these facts, Dr. Duchenne at once came to the conclusion, that the real cause of the paralysis was to be referred to some alteration either of the brachial and cervical plexus or of that portion of the spinal cord from which they derive their origin. On further examination a month after by M. Nélaton, who then for the first time took charge of the patient, he was found to be affected with tertiary symptoms of syphilis. That distinguished surgeon thought that some kind of exostosis might be the cause of the paralysis, and accordingly prescribed the proto-iodide of mercury. After some days the pain ceased, and then the paralysis gradually disappeared from the muscles which had not lost their electro-muscular contractility.

Treatment.—For restoring the paralyzed and wasted muscles to their original condition, electricity is unquestionably the most important agent. It should be employed daily for at least ten or fifteen minutes, and each muscle should be separately faradized. The period when the treatment by electricity should commence must vary according to the peculiarities of the case. If the electro-muscular contractility remain intact, faradization should be employed as soon as possible. But when this property is lost —that is, when the nerve influence is no longer supplied to the muscles, and more particularly when the muscular sensibility is impaired—the treatment by electricity is of no service, and should not be employed until some months after the injury, or until there is good reason to believe that the nerve-lesion is repaired. In addition to electricity, friction and shampooing should be employed, with passive motion, and voluntary exercise of the muscles, as soon as voluntary control is in any degree restored. The douche is often of great service, particularly if hot and cold water be alternately used. Care should be taken to preserve warmth in the affected part. When flexion or extension of a limb occurs in consequence of contracted muscles, splints, bandages, and other apparatus will be necessary.

When the effects of the nerve-lesion are aggravated or prolonged by some peculiar diathesis, or when the health of the patient is suffering from severe pain and want of sleep, general as well as local treatment must be adopted. Narcotics, iron, and quinine, cod-liver oil, and phosphorus are the most worthy of recommendation. The hypodermic method is the best mode of administering narcotics. If morphia be employed, the first injection should not exceed the sixth of a grain.

(2.) *Changes due to Idiopathic Affections of Nerves.*

Although traumatic lesions of nerves give rise to the most serious nutritive changes in the tissues to which those nerves are distributed, it is not uncommon to find that idiopathic affections of nerves are followed by changes of a similar nature.

The principal alterations in the nutrition of the skin resulting from idiopathic neuritis and neuralgia are manifested in the form of herpetic eruptions. Rayer, I believe, was the first to point to neuralgia as the cause of these eruptions, while other writers, including even Valleix and Cazenave, regarded the neuralgia as a consequence of the cutaneous affection. Rayer's opinion, however, has been fully confirmed by subsequent observation. The pain is frequently found to precede the eruption, while the latter is sometimes seen to follow the course of the affected nerve.

Barensprung has recorded a very valuable case, to which I have already alluded, and which proves in the most convincing manner, the close relation between idiopathic inflammation of nerves and herpes zoster. The patient was a child one year old. The eruption extended round one side of the thorax from the sixth to the ninth rib, and after death, which resulted from tubercular disease, the roots of the sixth, seventh, and eighth intercostal nerves, but especially the seventh, were increased in size and of a red color, in consequence of the presence of enlarged and tortuous vessels in the neurilemma. The diameter of the seventh intercostal exceeded by more than one-half that of the fifth or the ninth. The corresponding intervertebral ganglia were firmly adherent to the intervertebral canal; their connective tissue presented an inflammatory redness, and they were decidedly increased in size.[1]

MM. Charcot and Cotard have related the equally interesting case of a woman, aged seventy-eight, from whom a cancer of the right breast was removed in August, 1865. In October of the same year, she complained of sharp pains in the right shoulder, and in the right half of the neck. These pains were continuous, but increased in their severity at intervals, during which the patient appeared to suffer the most acute pain. About December 15 of the same year, an herpetic eruption made its appearance over the whole right half of the neck, limited exactly, both before and behind, to the median line. The eruption occupied all the other parts of the skin which are supplied by branches of the cervical plexus on the right side, but was not followed by any diminution of pain. The patient died on December 26, after symptoms of effusion into the pleura on both sides. On post-mortem examination it was found that while both the anterior and posterior roots of the spinal nerves in the cervical region were perfectly healthy, the intervertebral ganglia, as well as the compound tracks formed by the union of the two roots, presented a slight tumefaction, and a vascularity which was manifested by a bright red color. The difference was striking when the corresponding parts on both sides were examined.[1]

Among the most remarkable cases of neuritis giving rise to herpetic eruptions of the skin, are those which M. Leudet, of the Hôtel-Dieu of Rouen, has shown to be caused by the inhalation of carbonic acid.

When the symptoms of asphyxia have subsided, it is not uncommon, after a variable number of days, to find certain disorders both of sensibility and motion. The lower extremities are the parts which are usually affected, although different parts of the nervous system are sometimes involved. In one case which proved fatal, M. Leudet found the right sciatic nerve at least one-third thicker than the left; its neurilemma was injected, thicker, and more indurated than that on the opposite side.

In these singular cases, the skin was affected by eruptions similar to herpes. These eruptions appeared almost immediately after the subsidence of the symptoms of asphyxia, and in general, lasted only a short time.[2]

Herpes is not the only cutaneous eruption that has been found to follow neuralgia and neuritis, whether traumatic or idiopathic: lichen has been observed by Canuet in cases of neuralgia;[3] acne and erysipelas have been seen by Hasse[4] and Romberg[5] to accompany the same affection.

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[1] Barensprung, Annal. Charitekrank. zu Berlin, vol. xi., part ii., p. 96.

[1] Mémoires de la Société de Biologie, 1866, p. 41. From such observations as these, Barensprung seems to be quite satisfied that the intervertebral ganglia on the posterior spinal roots, give origin to the so-called trophic nerves; but it appears to me that facts do not warrant the conclusions at which he arrives.

[2] Recherches sur les troubles des Nerfs périphériques, et surtout des Vasomoteurs, consécutifs à l'asphyxie par la vapeur de charbon. Archiv. de Médecine, mai, 1865.

[3] Thèse de Paris, 1855, p. 29.

[4] Nervenkrankheiten, p. 62.

[5] Op. cit.

DISEASES AND INJURIES OF NERVES.

PART II.

REMOTER CONSEQUENCES OF NERVE-LESIONS.

By C. E. Brown-Séquard, M.D.

Revised by Roberts Bartholow, M.D., LL.D.

Introduction.

Two distinct groups or classes of symptoms may be caused by a lesion of a nerve; in one class the symptoms are the effects of the *loss of function* or *cessation of action* of the nerve; in the other, on the contrary, they are produced by *an action* of the injured or irritated nerve. In the first class, therefore, the symptoms depend on *lack of action*, while in the second, they are due just to the reverse, *i. e.*, *existence of action*, in a nerve.

Each of these two classes of symptoms may be subdivided. As there are at least four different kinds of nerves, four distinct kinds of symptoms of loss of function or cessation of action may be observed after a lesion of a nerve:—

1st. There may be paralysis of motion.

2d. There may be paralysis of centripetal nerves (sensitive, incito-motory, etc.).

3d. There may be paralysis of the vasomotor nerve-fibres, in consequence of which the bloodvessels may be distended and full of blood.

4th. There may be paralysis of the special nerve-fibres, the normal influence of which consists in giving activity to nutrition and secretion.

Leaving aside these four kinds of symptoms, I will confine myself here to the study of some of the effects of irritation of nerves. These effects may be grouped under two heads,—the *peripheric*, or *direct*; and the *remote*, *indirect*, or *reflex*. Of the peripheric, or direct effects, I will simply say that they give origin to five kinds of symptoms:—

1st. Contraction of muscles.

2d. Referred or subjective sensations (formication, pricking, feelings of pain, heat, cold, etc.).

3d. Diminution in the quantity of blood, owing to the contraction of bloodvessels in the part where the injured nerve distributes its fibres.

4th. An increase in the quantity of blood when the irritated nerve-fibres are those having normally the power of increasing the interchange between the blood and the tissues.

5th. In consequence of one or the other, or of a combination of the just-mentioned kinds of changes in the circulation of blood, there are various alterations of nutrition or secretion in the eyes, the skin, the joints, etc.

Of these five kinds of effects of irritation of nerves, four, viz., the first, third, fourth, and fifth, may also be caused either by a genuine reflex action, or by some peculiar influence upon or through the nervous centres. I propose here to treat only of these four last kinds of symptoms.

All the functional affections or disorders, and most of the organic diseases, are frequently produced by an influence exerted upon the nervous centres by an irritation of any part of the length of a nerve. This irritation may occur in the ramifications of a nerve in a mucous membrane or the skin (and be due to worms, a calculus, etc., or to cold); or it may depend on an organic or a functional affection of the trunk of a nerve (as in cases of wounds, burns, tumors, or neuralgia). In most instances an inflammation of the various viscera owes its origin to a reflex influence on the organ which becomes inflamed, proceeding from the irritation of some cutaneous nerve-fibres by a draught of cold air. I will not say more here on this reflex origin of visceral inflammation caused by cold acting on the skin, my object being only to give an outline of the various effects of injuries or diseases of all parts of nerves excepting the network of their terminal ramifications.

Of the various reflex and other remote effects of irritation of centripetal nerves, the following are the principal, of which I propose to speak successively; *epilepsy*, *tetanus*, *hysteria*, *catalepsy*, *chorea* and other *convulsive affections*, *trembling palsy*, *paralysis* of various kinds (*local paralysis*, *hemi-*

plegia, etc.), *anæsthesia*, *amaurosis*, *deafness*, *collapse*, *insanity*, *delirium*, *aphasia*, *coma*, *neuralgia* and other *painful affections*, *inflammation*, *atrophy*, *hypertrophy*, and other *morbid alterations of nutrition and secretion*. After having mentioned clear and positive facts, showing that all these affections may be caused by an injury to, or a disease of, a nerve, I will briefly give the rules concerning the diagnosis and treatment of these effects of injuries and diseases of nerves. This essay will therefore consist of two sections: the first, relating to facts demonstrating the existence of a great variety of reflex and other remote effects of irritation of centripetal nerves; the second, giving the principal features and rules of diagnosis and treatment of these effects of diseases and injuries of branches and trunks of nerves.

Section I.—Affections of the Nervous Centres and other Organs, Caused by an Injury to, or a Disease of, a Nerve.

Epilepsy.—Of all the nervous and other complaints that may be due to an irritation starting from the trunk, branches, or ultimate ramifications of nerves, very few, if any, are more frequent than epilepsy. Diseases of all the mucous membranes, or their irritation by worms, diseases of the cerebral or spinal meninges, dentition, etc., are known to be frequent causes of this convulsive affection. But it is not so well known, that an injury to, or a disease of, a nerve, not rarely produces epilepsy. Indeed, even a man of great authority as regards epilepsy, Dr. Herpin,[1] has lately maintained that in cases in which this affection seemed to have been caused by an external injury, it was, in reality, due to a disease of the nervous centres. It is most important that medical practitioners should not be misled by such an opinion. The rational treatment of that form of epilepsy which appears after a wound, or an organic affection, of a nerve, would certainly be neglected if such a view were admitted. It is, therefore, necessary to demonstrate that in a number of cases an epileptiform affection and also the most genuine epilepsy have been caused by a lesion of a nerve. This demonstration is given by the following kinds of proof:—

1st. In a great many cases, epilepsy has appeared in persons in whom there was no other cause for its production but a wound, a burn, a tumor, an inflammation, or a neuralgia.

2d. In a number of the above cases a peculiar sensation, generally miscalled aura epileptica, arose from the seat of the irritated nerve before all or most fits.

3d. In many of the same cases, the application of a ligature round a limb above the seat of the irritation often prevented the occurrence of fits.

4th. In some of the same cases a pressure on the seat of the external irritation invariably brought on a fit.

5th. In many cases of epilepsy apparently due to an irritation of a nerve, the section of that nerve above the seat of irritation, or the amputation of the limb; the extirpation of a tumor, of a cicatrix, of a decayed tooth, of a carious bone, etc., have cured the patient.

6th. I have discovered, in certain animals, that the irritation of the sciatic nerve by a broken bone, or by some other causes (crushing, tying, or cutting), invariably produces a temporary or persistent epilepsy. This convulsive affection never disappears without treatment, unless the irritation has ceased in the sciatic nerve.

These various facts clearly prove that epilepsy may be due to an irritation of a nerve, and exist without any serious organic change in the nervous centres. For the details of cases like those I have mentioned I will refer the reader to the new edition of my work on epilepsy, which will soon be published. I will only say here, that some of these cases have been observed by perfectly reliable men, such as Sir Astley Cooper, Sir Benjamin Brodie, Dieffenbach, Baron Larrey, etc. I will give one of those cases as a good specimen of reflected epilepsy. It was put on record by Dr. W. Laing, of Aberdeen.

M. D., aged twenty-one, had the left hand lacerated by machinery. She went on well till the night of March 6, when she was seized with convulsions, and, after a day or two, with trismus and other tetanic symptoms. On April 7 she was dismissed *cured;* but on June 24 she returned to the hospital. About a fortnight before her readmission she suddenly fell down in an epileptic fit; and since, the attacks have become more and more frequent, recurring five or six times a day, and lasting about five minutes, after which she remained a considerable time in a state of stupor. On the 25th the fits were so severe that she was put in the strait-waistcoat. When the fits were slight, they were confined chiefly to the injured arm. On touching the fingers smartly, the arm was convulsively withdrawn; and, when this was done while she was lying in a state of stupor, violent convulsions of the arm were produced. The patient often felt a sensation arising from the injured hand previous to her fits. As the remainder of the hand was of little use, the forearm was amputated; the patient never had the slightest appearance of epilepsy after the operation, and was dismissed cured, a month afterwards. The digital branches of the median nerve and a branch of the ulnar were found enlarged to four or five times their usual size, and their extremities bulbous, and firmly imbedded in a hard cicatrix.[1]

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[1] Des accès incomplets d'épilepsie, par Th. Herpin, p. 36. Paris, 1867.

Tetanus.—Referring to the article on TETANUS in the first volume of this work, I will only say a few words on the important questions relating to the nature and to the local treatment of this affection.

I am really surprised that some persons still doubt that it is owing to a peculiar influence, exerted on the circulation of the blood and the nutrition of the spinal cord and the medulla oblongata, by the irritation of a centripetal nerve, that tetanus arises from a traumatic lesion. I hope that the following facts and reasoning will show that this convulsive affection is truly dependent upon an irritation arising from the injured nerves, and not—as Dr. B. W. Richardson, Roser, Billroth, and others are inclined to admit—from toxæmia.

The relation between the wound and tetanus seems to be positively established—at least, in those cases in which the muscles attacked with spasms are on the side injured. Lepelletier, Sir Gilbert Blane, Swan, Dupuytren, and Mr. Curling,[2] who cites the preceding authors, have seen such cases. My friend, Dr. G. H. B. Macleod,[3] relates two cases of fatal tetanus, in which the tetanic spasms were almost entirely limited to the side injured. Baron Larrey states that when the wound causing tetanus is in the anterior part of the trunk, emprosthotonos is the form generally observed.

Other strong arguments in favor of the view that traumatic tetanus is caused by a peripheric irritation, are: 1st, that very frequently the muscles in the neighborhood of the wound are either the first attacked or the most affected with spasms; 2d, that in many cases it has been observed by myself and others, that even a slight pressure on the wound or the cicatrix has increased the spasms or produced them, in periods of relaxation (after chloroformic anæsthesia, for instance).

It may seem strange that tetanus will sometimes follow even the slightest wound, and that it will come at any period of inflammation or cicatrization, and even when there is no pain at all in the wound or its neighborhood. But this last fact is no objection to the view that tetanus takes place in consequence of an irritation starting from these parts, as we know that all the morbid or normal influences on circulation and nutrition in the nervous centres, may proceed from the periphery, without any pain, or even without the least perceived sensation.

The kind of lesion which most frequently produces tetanus, implies that there is a great irritation of nerves, although there may be no marked pain. In a table given by Mr. Poland in this work (Vol. I., p. 566), we find that out of 1364 cases of major and minor operations at Guy's Hospital, there is but one case of tetanus; while out of 398 cases of compound fractures and 594 cases of wounds of all varieties, there were 18 cases of tetanus; giving a proportion, when the nerves were simply divided, by a sharp knife, of one case of tetanus out of 1364 patients; and of one case out of 55 patients, after wounds and fractures, when the nerves were bruised or much irritated. In a statistical table given by Dr. Friederich,[1] the influence of great irritation of nerves in causing tetanus is also demonstrated: out of 176 cases of that affection, only 11 occurred after amputation, and 33 after gunshot wounds, while 61 were due to contusion or comminutive fracture, and 71 to wounds by puncturing instruments, or dilaceration and bruising of tissues by nails, pieces of wood, etc. Dr. Lawrie's statistics agree with those of Friederich.[2]

The cases of cure of tetanus either by an amputation of a limb or by section of a nerve, clearly prove the dependence of this affection on an irritation starting from some peripheral part of a nerve. The same conclusion flows out from numerous facts like the following, to which I might add many others. Tetanus is pointed out to have been caused by a small splinter of bone sticking in the radical nerve (Hennen), by a portion of a whip embedded in the cubital nerve (Dupuytren), by an application of caustic potash on the coraco-brachial nerve (Frere), by shot corns in the tibial nerve (J. Hutchinson), by a splinter of wood in the radial nerve (Morgan), by neuritis (Curling, Lepelletier, Froriep, and others), by ligatures on nerves of limbs (Larrey, Béclard, Portal, etc.), by a small piece of broken bone passing through the peroneal nerve (Wutzer and O. Weber), by the crushing of the anterior tibial nerve between fragments of broken bone (Alquié), and by partial division or tearing of nerves (Swan, Liston, Billroth, etc.). In cases in which the spinal cord was either inflamed or rendered extremely excitable, the section of a nerve or an amputation has been of no avail; and in some cases, also, in which an inflammation has been propagated high up in the trunk of a nerve, towards its roots, these operations have been useless; but such failures might have been avoided had these modes of treatment been applied earlier, and had all the nerves been divided higher up than they have been. I need not say that the simple division of a nerve should always be preferred to an amputation, unless there are some special reasons for this last operation.

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[1] Aberdeen Infirmary Reports, in Lond. Med. Gazette for Dec. 25, 1840.

[2] A Treatise on Tetanus, pp. 87, 174. London, 1836.

[3] See his excellent work, Notes on the Surgery of the War in the Crimea, pp. 155–161. 1858.

[1] De Tetano traumatico, Berolini, 1837.

[2] The Glasgow Medical Journal for Oct., 1853; and The Association Medical Journal, Nov. 18, 1853, p. 1017.

Hysteria.—The extreme frequency of this affection in women renders it difficult to prove that it may be due to an irritation of a nerve. However, there are cases in which it seems quite clear that hysteria was really caused by a wound, or the irritation of a tumor.[1]

Two very interesting cases are reported by Dr. Parsons;[2] one observed by himself, the other by Dr. S. P. Hildreth.

Morgagni mentions the case of a young girl who, after a wound to a finger by the biting of a sparrow, was attacked with fits of trembling and screaming, recurring sixteen or eighteen times a day.[3]

Raynaud relates the case of a woman who, after having received a blow on the breast, had a first attack of hysteria. Two small tumors soon appeared at the injured place, and for seven years hysterical attacks occurred several times every day. These tumors were removed by Boyer, and immediately after the operation the attacks ceased, and did not recur again.[4]

Three years ago, in a patient of mine of a highly nervous temperament, but who never had had any marked symptoms of hysteria, convulsions and delirium, with some degree of lock-jaw, frequently appeared and ceased, during three or four days, after a slight wound by a needle in front of the knee-joint, just below the patella. The needle broke at the time of the accident, and a small part of it remained under the skin. As soon as the pain ceased in the little wound, after the extraction of the point of the needle, the patient got well, and has had no return of hysterical symptoms since.

Brachet has seen a temporal neuralgia produce hysterical fits every time it appeared, and for all the time it lasted.[1]

Sir Benjamin Brodie mentions several cases in which a wound was the cause of hysteria.[2]

A very curious case of hysteria in a man, cured by the removal of a tumor of the external ear, has been published by Dr. Bastien, in his inaugural dissertation.[3]

In hysteria as in epilepsy, an aura starting from some point of the periphery of the body may precede an attack, and also the aura may be created by a pressure on some part. In those cases the same means of treatment as in epilepsy may prove useful. These facts, and the cases I have briefly mentioned, show that hysteria, like epilepsy and tetanus, may be caused by an irritation of a nerve. I must say, however, that a persistent cure of hysteria is very rarely obtained. Various operations, such as extirpation of cicatrices, amputations, etc., to cure hysterical spasms due to an irritation of nerves, have proved beneficial only for a time, in several cases of Sir Benjamin Brodie,[4] of Mr. Hancock, Tyrrel, and Bransby Cooper.[5]

Catalepsy.—I have seen a case of this affection in which attacks were brought on at once by even a slight pressure on tender spots between the shoulders. Catalepsy, therefore may, like other neuroses, be produced by a peripheric irritation.[6]

Chorea.—St. Vitus's dance may be caused by an injury to a nerve.

In a case of Dr. Borelli, of Turin, chorea was caused by a neuroma of the foot, in a child thirteen years old. This convulsive affection was at once lessened, and in four days cured, after the extirpation of the neuroma.[7] Andral mentions a case of chorea caused by the irritation of a finger by a retroverted nail.[8] Dr. J. Malden has cured a woman of choreic movements by the extraction of a decayed tooth.[9]

Hydrophobia.—I will try to show elsewhere that the symptoms of this terrible affection depend on a local effect of the virus on the wounded nerves, and that some chance of cure might be obtained by division of the irritated nerves. Already in the last century, G. Hicks proposed this means of treatment against hydrophobia.[1] I owe to Dr. Stokes, of Dublin, the mention of a most important case, showing that there is good ground to hope that hydrophobia might sometimes be cured by amputation or division of a nerve.[2]

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[1] An interesting case, published by Hamilton (Dublin Journal, 1838, vol. xiii., p. 42), shows how careful we must be as regards the signification of symptoms in hysterical patients. All the most characteristic features of neuritis existed in a patient after a wound, but they disappeared *at once* after a violent fit of hysteria.

[2] American Journal of the Medical Sciences, April, 1851, pp. 307, 312.

[3] De Sedibus et Causis Morborum, Lutetiæ, 1822, vol. vi., p. 613, epist. liv., § 45.

[4] Raynaud, in Archives de Médecine, 1829, vol. iii., p. 434.

[1] Traité de l'Hystérie, 1847, p. 253.

[2] Lectures illustrative of certain Local Nervous Affections, 1837, pp. 40–46.

[3] Thèse inaugurale, soutenue le 20 novembre, 1855. Paris.

[4] Loc. cit., p. 83.

[5] Lancet, March 20, 1852, pp. 281–283.

[6] Hufeland relates a case of attacks of running and of *catalepsy*, caused by a blow on the head, and cured by trepanation (cited by Roth, Musculation irrésistible, p. 32).

[7] Gazette des Hôpitaux, 1850, p. 454.

[8] Cours de Pathologie interne, vol. iii., p. 304.

[9] Archives de Médecine, mars, 1855, p. 338; from Trans. Provincial Associat., vol. xix.

Tremulous movements.—The so-called *trembling palsy*, which so often consists simply in involuntary tremulous movements, without any palsy, may be caused by an irritation starting from a nerve.

Sabatier[3] relates the case of a young man, who, after a wound of the saphenous nerve, near the knee, was attacked with violent trembling of the leg and thigh, which lasted many months. In a patient sent to me by Mr. Erichsen, an injury to a nerve of the left arm has produced trembling in both arms. In another patient, for whom I was consulted by Mr. M. H. Collis, of Dublin, shaking palsy began in a fractured limb and thence extended to the other limbs. Several cases are on record showing that the shaking due to an external injury may become general.[4]

Rotatory convulsions.—I have found that an injury to the auditory nerve in animals is at once followed by rotatory movements. I do not know of any case of wound of that nerve in man having produced the same symptoms; but several cases are on record in which these movements have been observed in man when the auditory nerve was irritated by an inflammation or some other cause (an injection of caustic, etc.).

I would refer for these cases to my work on the Central Nervous System, p. 195, only adding here that since that publication I have seen three cases of that peculiar kind of involuntary movements, caused by an affection of the internal ear. An irritation of other nerves may produce the same effect. Dr. Krieg relates the case of a patient wounded on the forehead, and on whom a touch of the injured skin produced attacks of exceedingly rapid rotatory movements.[5]

Local convulsions.—It is well known that wounds of the branches of the fifth pair of nerves may by a reflex influence produce spasms of the muscles of the eyes, or trismus, or histrionic convulsions. It is known also that muscles of the limbs and trunk may be seized with either tonic or clonic reflected convulsions from an irritation of a nerve. Sneezing, hiccough, cough, and vomiting are sometimes also caused by the reflex influence of wounds. Spasms of the sphincters (*vesicæ et ani*), of the œsophagus, of the larynx, etc., are also among the reflected phenomena not rarely caused by an irritation of superficial nerves.

Contracture of bloodvessels.—Many experiments establish that bloodvessels will contract by a reflex action.[1] In hysteria and other nervous affections a reflex vascular contracture frequently occurs.

An eminent American clergyman has given me the details of a most remarkable case of prolonged reflex contracture of bloodvessels, he himself being the patient. After having violently struck his leg (two inches above the knee) against a piece of paling-fence, he was soon apparently cured of the local injury; but an influence upon the bloodvessels of the limb showed itself; so that for a whole winter it remained extremely cold, and ever since, for twenty years, its temperature has been lower than that of the other leg. Swan[2] has also observed a case of permanent reflex contracture of bloodvessels. I will revert to this subject in speaking of reflex muscular atrophy.

Paralysis.—I will not enter here into the discussion of the great question of the mode of production of paralysis when caused by an irritation of a nerve. I will only say that there are two absolutely different kinds of paralysis produced by such an irritation: in one kind a congestion or even an inflammation takes place in a part of the nervous centres by an influence exerted by the peripheric irritation, and the paralysis then produced is accompanied by the usual symptoms of congestion or inflammation of some part of the brain or spinal cord; while in another kind the paralysis exists without any symptom of congestion or inflammation of the nervous centres. This second kind of paralysis caused by an irritation of a nerve is most likely due, at least in some cases, to a reflex contracture of bloodvessels[3] in a part of the nervous centres. In some cases, if not in all, it may also depend, however, on a peculiar influence exerted on nerve-cells, in these centres, by an irritation starting from peripheric nerve-fibres, producing what has been called *inhibition*, or, at any rate, changing the condition of activity of these nerve-cells.

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[1] Lond. Med. and Phys. Journal, vol. xvii., p. 277.

[2] The case above mentioned, and the reasons I have for the hope I have expressed, will be found in the Appendix to my work, Lectures on the Physiol. and Pathol. of the Central Nervous System, p. 261 et seq. 1860.

[3] Médecine opératoire, vol. i., p. 254.

[4] Inquiry concerning Constitutional Irritation, by B. Travers, p. 115, 1826; and Treatise on Diseases and Injuries of Nerves, by J. Swan, p. 124, 1834.

[5] Histoire de la Musculation irrésistible, par le Dr. Roth, p. 78. Paris, 1805.

[1] See my researches on this subject, with my friend Dr. Tholozan's (Journal de la Physiol. de l'Homme, etc., 1858, p. 497); and Dr. J. S. Lombard (Archives de Physiol. norm. et pathol., 1868, p. 688).

[2] Loc. cit., p. 157.

[3] An able physician, trying to ascertain

Paralysis of the various muscles of the eye, including the iris, is pretty often observed in cases of wound of the infra- or supraorbital nerves, or in cases of neuralgia. I have seen several cases of that kind of paralysis (caused by a neuralgia), and all characterized by their evident relations with that cause.

In a case which I have carefully watched, a sprain of *one arm* at the elbow-joint soon produced a paralysis of *both arms*, but more marked in the uninjured arm than in the other. Every change in the degree of pain in the injured elbow was accompanied by a corresponding change in the degree of the paralysis. The pain has now ceased for many years, and the paralysis, which ceased with it, has not reappeared, the two arms having at present as great power as they ever had before the injury.

Baron Larrey states that almost all the men who received slight wounds of the shoulder in the Syrian campaign were attacked with paralysis of the injured limb. These patients were cured in Egypt, where the air is purer than in Syria. In some, at least, of these cases, the paralysis was clearly due to an influence exerted on the nervous centres by the irritation of superficial nerves.[1]

Facial paralysis from a neuralgia is not rare; in one case this paralysis and neuralgia were both caused by the irritation of the infra-orbital nerve, and cured by the extirpation of the irritating cause, a piece of porcelain.—(Jeffreys, quoted by Tillaux, Des Affections chirurg. des Nerfs, p. 15; Paris, 1866.) Fabricius Hildanus, quoted by J. Barthez (loc. cit., p. 83, vol. ii.), relates a case of paralysis of one arm, caused by a piece of glass in the ear.—The arm may be paralyzed by an influence arising from very distant nerves. Drs. S. W. Mitchell, Morehouse, and Keen[1] give two interesting cases, in one of which the irritated nerve was the sciatic, and in the other the crural.

Parsons mentions a case of paralysis of the face and arm, caused by a prick.[2]

Roche, in an able dissertation, relates the case of a physician in whom general convulsions and afterwards complete paralysis of sensibility and motion in the left arm appeared, after the painful extraction of two teeth of the left upper jaw. There was also loss of speech, but no alteration of intelligence. In an hour the paralysis disappeared, and speech returned.[3]

As regards the lower limbs, I will simply refer to my work On Paralysis of the Lower Extremities, in which a number of facts show that a peripheric irritation of nerves may produce that form of loss of movement.

I will only say here that one of the lower limbs may be alone paralyzed, as in a case by A. Boyer, in which an irritation from a dislocated elbow was (according to all appearances) the cause of paralysis of the corresponding lower extremity.[4]

Cases of more extensive paralysis are also reported by the three American authors I have named. Schenkius (Barthez, loc. cit., vol. ii., Notes, p. 41), has seen a case of general paralysis produced by a wound of the eyebrow.—I have been consulted by an American officer who became paralyzed in a slight degree in the four limbs, chiefly the right arm and the left leg, from a gunshot wound of the cervical plexus, and partly also of the brachial plexus of the right side.

I have seen a most interesting case of general paralysis, caused by an irritation of the nerves of the penis, cured by the successful treatment of balanitis and the operation for phimosis.

Hemiplegia from peripheric irritation is less frequent than partial paralysis or paraplegia.

There are, however, some remarkable cases on record. In one of them, published by Dr. Shearman, there was hemiplegia of the right limbs, caused by tic douloureux of the right inferior axillary nerve. Tonics and galvanism cured the patient.[5]—In another case, recorded by Baron Larrey, a lady was attacked with hemiplegia on the same side where she suffered from a facial neuralgia,

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the correctness of a statement of mine, that an irritation of nerves of the kidney may, by a reflex action, produce a contraction of bloodvessels of the pia mater of the spinal cord, has been unable to succeed, owing to the fact that after having laid bare that nervous centre, he vainly looked for bloodvessels on the surface he had under his eyes. Had he waited some time, he would not only have seen bloodvessels appear where he at first had not seen any, but he might have had the proof that there is a contraction of the bloodvessels of the surface of the spinal cord, powerful enough to render them almost invisible, and occurring when the incito-motor nerves of the skin and other parts of the back are strongly irritated in the operation of laying bare the cord.

[1] Mémoires de Chirurgie militaire, 1812, vol. ii., p. 153.

[1] Circular No. 6, Reflex Paralysis. Philadelphia, 1864. See also a paper on "Paralysis from Peripheral Origin," by Dr. S. Weir Mitchell. New York, 1866.

[2] Amer. Journ. of the Med. Sciences, April, 1851, p. 310.

[3] Des Accidents nerveux traumatiques, p. 65. Thèse. Paris, 3 janvier, 1861.

[4] Gazette médicale de Paris, 1834, p. 358.

[5] Provincial Medical and Surgical Journal, May 15, 1844.

e hemiplegia being more evident during e attacks of neuralgia; both affections were red by moxas.[1]

I have collected thirty-seven cases in which here was hemiplegia, due to an irritation of ither the auditory or the trigeminal nerves ear their origin, or of the crus cerebelli. I ave tried to show elsewhere that, in those ases, the paralysis which exists in the limbs on the side of the irritated part, is probably due to a reflex influence.[2]

Sir Astley Cooper mentions the following fact: "Mr. Toulmin attended a lady on account of her suffering severely from a diseased tooth, and she appeared also to be afflicted with hemiplegia. Mr. Toulmin extracted the tooth, and in a short time the paralytic affection entirely subsided.[3]

Anæsthesia.—A reflex anæsthesia is not rare in cases of neuralgia.

Many cases of reflected anæsthesia from a wound and other injuries of nerves are on record. A remarkable case of Baron Larrey (*loc. cit.*, vol. v., p. 35, 1821), and an important one of Roche (quoted in my Lect. on the Centr. Nerv. Syst., p. 131), particularly deserve to be mentioned. I have observed anæsthesia of the arms in an able lawyer of London, which was caused by a blow on the back of one knee. Several interesting cases have been published by Drs. S. W. Mitchell, Morehouse, and Keen. In one case a shell-wound of the left thigh produced anæsthesia of the right thigh.[4] I have several times seen anæsthesia of the whole of one side of the face, in cases of neuralgia of one part of the trigeminal nerve on the same side. I have seen also a case of anæsthesia of a part of the forehead and face, in consequence of the irritation of a branch of the fifth pair, on the cheek-bone, by a bruise. In those cases the anæsthesia subsided when its cause was cured.

Amaurosis.—The cases of amaurosis due to an irritation of the trigeminal nerve are frequent enough for my dispensing with quotations of cases. In the first edition of this work I had quoted cases of Wardrop,[5] Notta,[6] Dr. Noyes, of New York,[1] and Mr. J. Hutchinson.[2] This last observer has since published several able papers on this subject. I have myself seen five or six cases of amaurosis evidently due to an irritation of the infra- or supraorbitalis nerve. Cases of amaurosis due to an injury of a nerve of the trunk or limbs are not frequent. Dr. J. B. Colhoun has reported a remarkable case of sudden and almost complete amaurosis of both eyes, caused by a gunshot wound of the scapula.[3]

Deafness. — A neuralgia of the face sometimes produces loss of hearing; other kinds of irritation of branches of the fifth pair may also cause deafness. Dentition and decayed teeth have been pointed out as having had the same effects. Pearson relates a case of wound of the thigh in which deafness was among the symptoms produced (Medical Facts, vol. vi. p. 109).

Collapse.—I only wish to say here, that my experiments on several species of animals, compared with facts observed in man, show that there are, at least, three different kinds of collapse: the first, one in which a reflex arrest or diminution of the heart's action predominates; the second especially characterized by a great diminution of breathing, produced by a peculiar inhibitory influence on the central organs of respiration, the heart continuing to beat with more or less vigor; the third, which I have recently described in my lectures at the Faculty of Medicine of Paris, consisting in a powerful influence exerted by a peripheric irritation on the nervous centres of the nerves able to act on circulation, secretion, and nutrition, and, through that influence, producing a cessation of some of the ordinary interchanges between the blood and the tissues. Two opposite conditions of the bloodvessels may exist in this third form of collapse; these contractile tubes may be dilated or contracted. But in one or the other of these conditions, the blood, instead of being black, in the veins, is reddish and sometimes arterial-looking, and the production of heat ceases in the capillaries. This third form of collapse, consisting, as I have said, in a cessation of the ordinary chemical interchanges between the tissues and the blood, is the most prominent in a large number of cases, and it is also the most dangerous of the kinds of shock or collapse.[4]

Loss of smell, taste, and hearing.—The celebrated experiment of Magendie, showing that a section of the trigeminal nerve may cause a loss of the five senses in the head, is, most likely, to be explained by a reflex influence. At any rate, an important case of Dr. Blondlot shows that an irritation of the infraorbitalis nerve (wounded) may produce, by a reflex action, loss of hearing, taste and smell.[1]

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[1] Recueil de Mémoires de Chirurgie, vol. v., 1821.

[2] Lect. on the Physiology and Pathology of the Central Nervous System, pp. 201, 264.

[3] Lect. on the Principles and Practice of Surgery, vol. i., p. 6, 1824. Dr. Castle, of New York, mentions a case of paraplegia caused by decayed teeth, quickly cured by the extirpation of these teeth (Lancet, 1846, vol. ii., p. 267).

[4] See an excellent paper by Dr. S. Weir Mitchell, on "Paralysis from Peripheral Origin," reprinted from the New York Medical Journal, 1866, p. 59. I have lately found that the irritation of the sciatic nerve in the lower animals produces a slight anæsthesia of the lower limb on the opposite side, and of the face and neck on the side of the irritation.

[5] Med.-Chir. Trans., vol. xii.

[6] Archives gén. de Med.-Chir., etc., juillet, 1854, pp. 12–21.

[1] American Med. Times, March 15, 1862.

[2] Med. Times and Gazette, May 7, 1859.

[3] The Medical Examiner, p. 806, vol. ii. Philadelphia, 1839.

[4] See my article on "Syncope," in Archives de Physiol. normale et pathol., 1869, p. 767.

Neuralgia.—The frequency of *tic douloureux*, caused by an irritation of a small part of the dental nerves, is such, that it is certainly useless to mention cases. But tic douloureux may be caused by irritations of other nerves, while also an irritation of the nerves of the jaw may cause a neuralgia elsewhere than in the face. Mr. Harvey has seen a case of tic douloureux caused by a tumor of the head. It was ascertained several times, that pressure on the tumor brought on a severe attack of tic. The patient was cured by the removal of the tumor.[2]

In the first edition of this work, I gave cases of reflex neuralgia reported by Mr. Gay,[3] Dr. R. Rowland,[4] Parsons,[5] Tavignot,[6] Dr. Greene, of New York,[7] Wardrop,[8] Maréchal,[9] Dr. Castle, of New York,[10] Marchal de Calvi,[11] and Romberg.[12] The view I then maintained, that a neuralgia may be caused by a reflex action, being now pretty generally admitted, I only give here a reference to these cases, and to important publications made on this subject by Ch. Londe,[13] J. Mason Warren,[14] and Ch. Mauriac.[15]

Delirium.—I will simply mention here three cases which show quite decisively that delirium may be caused by an injury to a nerve.

A boy, aged fourteen, trod on a piece of glass, which penetrated the big toe, but was removed. Four years after, he began suddenly to talk in a very strange, wild way; true delirium set in, and nothing appeased the patient. Near the ball of the big toe a small reddish elevation was found. The moment pressure was made upon it, the seizure returned with violence. An incision was made and a trifling piece of glass was removed. Much as the patient had raved during the operation, with equal suddenness did all the symptoms vanish; and he was surprised on being told of all the senseless things he had uttered.[1]

I have published a case very similar to this, which I owe to the kindness of Mr. Campbell de Morgan, and in which the attacks of delirium took place every time pressure was made on a wound of a toe containing a foreign body. As soon as the irritated part was taken away by the cut of a bit of skin, the patient became rational, and remained so when pressure was made on the wound.[2]

Mr. Sherwin has seen a woman, who, after having been bled, was attacked with pains in the arm, neck, and face, with spasms in those parts, and delirium. After the symptoms had continued a fortnight, a deep incision above the cicatrix quite cured her.[3]

I need not speak here of the delirium that follows amputation or other great operations. The causes are many that bring on delirium in such cases. Among the principal causes I will point out a great loss of blood, and the anxiety of the patient.

Aphasia.—An interesting case shows that this affection also can be produced by an irritation of a nerve. Dr. Guyot has seen aphasia occurring every time an attack of facial neuralgia took place; the patient was cured by quinine.[4]

Inflammation.—Cases of inflammation of the eye due to a reflex action are so frequently met with, that I need not stop here to prove their existence. Any one who will read the facts published by Dr. W. Mackenzie, in his admirable work on the Diseases of the Eye, by Mr. R. Taylor,[5] by Dr. Brondeau,[6] and by several other more recent writers, among whom I will only quote Dr. J. J. Maats,[7] a pupil of Prof. Donders, will soon be convinced that an inflammation of any part of one eye (the retina, the cornea, the conjunctiva, etc.) may be caused by a wound or an inflammation of the other eye; and that if the first diseased organ is extirpated, the other is often soon cured. Cases of ophthalmia owing to a wound or a neuralgia of the infra- or supraorbital nerves, or caused by an irritation of the dental nerves, are also not rare. Dr. Busschaert has published a curious case of ophthalmia produced by obstruction of the external auditory canal.[1]

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[1] Gazette médicale de Paris, 1834, p. 44.

[2] On the Nature and Treatment of Tic Douloureux, etc., by Dr. Henry Hunt, p. 114, 1854.

[3] The Lancet, 1846, vol. ii., p. 119.

[4] A Treatise on Neuralgia, by R. Rowland, p. 18. 1838.

[5] American Journal of the Med. Sciences, Oct., 1854, p. 423.

[6] Gazette médicale de Paris, 1845, p. 547.

[7] Dublin Journ. of Med. Sc., 1838, vol. xiii., p. 53.

[8] Trans. of the Med.-Chirurg. Soc., vol. viii., 1817, p. 246 et seq.

[9] Case of Maréchal, cited by Marchal de Calvi, in Annales de Chirurgie, 1844, vol. iv., p. 69.

[10] The Lancet, 1846, vol. ii., pp. 266, 267.

[11] Annales de Chirurgie, loc. cit., p. 76.

[12] Lehrbuch der Nervenkrankheiten, 3d edit,, vol. i., pp. 23–35.

[13] Rech. sur les névralgies consécut. aux lesions des nerfs. Paris, 1860.

[14] Surgical Observations, with Cases and Operations. Boston, 1867, pp. 468, 471.

[15] Névralgies réflexes de l'orchite, in Gaz. Méd. Paris, 1869, Nos. 25 to 47; and 1870, Nos. 1 to 4.

[1] Joerdaens, in Hufeland's Journal, vol. iv., p. 257, cited by Dr. Martyn Paine, in his Medical and Physiol. Commentaries, vol. i., p. 425.

[2] Course of Lect. on the Physiol. and Pathol. of the Nerv. Cent., p. 185, 1860.

[3] Duncan's Medical Comment., vol. iv., cited by Mr. Hamilton in Dublin Journ. of Med. Science, vol. xiii., p. 51, 1838.

[4] Gazette hebdomad. de Médecine, 1867, p. 266.

[5] Medical Times and Gazette, 1857.

[6] Des Affections sympath. de l'un des Yeux. Paris, 1858.

[7] Nederlandsch Archief voor Genees- en

Dr. Rowland relates several facts which seem to prove that an inflammation in one side of the brain may be caused by an injury to a nerve in the other side of the body.[2] To the cases of inflammation of the brain mentioned by Dr. Rowland, I might add several others, among which the most significant have been recorded by Hennen,[3] R. Bright,[4] and Champsaur.[5] The well-known fact that sometimes, in traumatic tetanus, the spinal cord becomes inflamed, shows that a peripheric irritation may produce inflammation in that organ.

Inflammation of the testicle is also sometimes produced by a reflex action from an irritated nerve, as in cases by Sir Benjamin Brodie,[6] Barras,[7] Marrotte,[8] and others. Sir Astley Cooper[9] says that by irritation morbid actions are excited in distant organs, and adds: "thus inflammation is produced in the testicle from irritation in the urethra."

Inflammation of the abdominal or thoracic viscera may also be produced by a reflex action. Proofs of this assertion are abundantly furnished in Lecture X. of my work On the Central Nervous System. A reflex inflammation may be brought on to such a degree as to cause an ulcer, which nothing can heal until the cause (viz., the irritation of a nerve) is removed. Sir Astley Cooper mentions several cases of that kind.[10]

As well shown by Mr. J. Hamilton, there is sometimes in cases of wounds of nerves a deceptive appearance of inflammation with suppuration.[1]

Coma.—This most dangerous morbid state may also be caused by a peripheric nervous irritation.

In a case of Hirsch, quoted by Dieffenbach,[2] convulsions and coma accompanied local neuralgia, caused by venesection. The patient was cured by two deep incisions over the wound.—An immediate cure of coma and convulsions was also obtained in a case similar to the preceding, observed by Dr. Wilson.[3] Another case somewhat similar, has been recorded by Mr. G. Bell.[4]

Apoplexy. — Even apoplexy can be caused by a peripheric irritation.

A remarkable case of wound having caused neuralgia and apoplectic attacks has been observed by Dr. Maupin.[5] Other cases are mentioned in my old journal.[6]

Muscular atrophy.—I have seen a number of cases of atrophy of muscles produced by a reflex influence from an irritated nerve.

In one case *all the muscles of the thumb* wasted very rapidly after a deep wound of the ulnar side of the forearm having divided the ulnar nerve. This cannot be explained by the fact that that nerve sends a branch to two muscles of the thumb, as not only these two muscles, but others, and especially the abductor and the opponens, were notably atrophied.

A neuralgia very often produces atrophy in neighboring muscles. My friend and pupil, Dr. Cl. Bonnefin,[7] has seen nineteen cases of muscular atrophy caused by a neuralgia. A remarkable fact, observed in those cases, serves to explain how the atrophy was produced—there was a marked diminution of temperature, most likely due to a spasm of bloodvessels. The amount of blood was

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Natuurkunde, Deel ii., 1e Aflevering, pp. 8–52. Utrecht, 1865.

[1] Gazette des Hôpitaux, 10 octobre, 1857.

[2] On the Nature and Treatment of Softening of the Brain, p. 67 et seq. London, 1851.

[3] Military Surgery, p. 191.

[4] Reports of Medical Cases, vol. ii., pt. i., p. 52.

[5] Thèse inaugurale, p. 22. Paris, 1860.

[6] Lecture on Local Nervous Diseases, p. 16, 1837.

[7] Cited by Notta, in Archiv. de Méd., etc., p. 547, sept., 1854.

[8] L'Union médicale, p. 155, 1881.

[9] Lectures on the Principles and Practice of Surgery, by F. Tyrrell, vol. i., p. 4, 1824.

[10] Loc. cit., pp. 7, 8.

[1] Dublin Journal of the Medical Sciences, vol. xiii., pp. 50, 55. 1838.

[2] British and Foreign Medical Review, p. 332, vol. xxi., 1846.

[3] A Treatise on Diseases and Injuries of the Nerves, by J. Swan, p. 117, 1834.

[4] J. Swan, loc. cit., p. 119.

[5] Quoted by Marchal de Calvi, in Annales de Chirurgie, vol. x., obs. 7, p. 73.

[6] Journal de la Physiologie de l'Homme, etc., vol. v., 1862, pp. 619, 621.

[7] De l'Atrophie musculaire consécutive aux Névralgies. Paris, 1860. A long list of authors having spoken of muscular atrophy caused by sciatica, is given by Dr. Lagrelette, in his exhaustive work on that kind of neuralgia, entitled Étude histor. séméiolog. et thérapeut. de la Sciatique, pp. 34–35. Paris, 1869. See also Notta's paper in Archives de Médecine, sept., 1854, p. 557.

consequently diminished, and the wasting occurred owing to the lack of nutritive fluid. Some of the cases of wasting palsy related in Dr. Roberts's excellent work,[1] very likely belong to the class of reflex atrophy.

In a case recorded by Vallez, a wound of the infra-orbital nerve produced a reflex atrophy and paralysis of the face on the same side.[2]

Atrophy of the cellular tissue.—In some of the cases of atrophy of one side of the face, which Schott and Romberg have called facial trophoneurose, there was an irritation of some sensitive nerve, probably acting by a reflex influence. I saw a case of that rare affection, three years ago, in Boston (United States); its probable cause was an irritation of the dental nerves, which produced convulsions in one side of the face (the side where the atrophy was afterwards observed). I will refer for arguments leading to the conclusion that the cellular tissue is alone atrophied in that affection, to a remarkable essay by Dr. L. Lande.[3]

Hypertrophy.—Notta mentions cases of hypertrophy of the face and tongue caused by neuralgia.[4] I have seen a case of considerable hypertrophy of the bones and of the cellular tissue, in the face, which occurred after repeated attacks of neuralgia, in a lady whose general health was excellent.

Various kinds of alterations of nutrition and secretion.—The number of facts that might come under this head has considerably increased since the time that my friend, Sir James Paget,[5] first showed how great may be the direct and the reflex influences of the nervous system in disturbing nutrition. *Eruptions* of various kinds (*erythema*, *pemphigus*, *urticaria*, *acne*, and especially the different forms of *herpes*) are often produced by a reflex influence from an irrritated nerve, as proved by facts observed by Rayer, G. Simon, Delioux, Notta, Romberg, Hasse, Parrot, and more recently by Charcot, Barensprung, J. Hutchinson, H. F. Damon, Purdon, and others. I have seen several cases proving clearly the production of certain eruptions by a reflex action. Sir Astley Cooper relates a curious case of *fungoid granulations protruding through an ulcer* in the cheek of a lady, who was quickly cured after the extraction of a tooth.[1] In a case of *ulcerations* and wasting, probably due to neuralgia, Dr. Hooker cured the patient by dividing the popliteal nerve.[2] An *erysipelatous redness* and swelling has been seen by Sherwin in a case of wound of a nerve, and a *swelling* of the foot and leg has been observed by Dr. Watson, of New York, in a case of cut of the sole of the foot by a piece of glass.[3] *Œdema* is a frequent reflex effect of neuralgia. Hamilton has seen two cases of that serous effusion after injuries of nerves.[4] Those persons who know that even *gangrene* may be caused by an influence of the nervous system, as rendered so probable by Dr. M. Raynaud,[5] will not be reluctant to admit that it may be the result of a reflex influence from irritated nerves. Most likely it was not to embolism or to thrombosis, but also to a reflected nervous influence, that gangrene was due in three cases related by Sir William Fergusson,[6] Dr. Gubler,[7] and Dr. Grainger Stewart.[7] The case of Dr. Stewart is especially worthy of attention. *Altered secretions* are very often due to a reflex influence in cases of neuralgia, and sometimes in cases of wounds of nerves. *Diabetes* is most likely produced by a reflex influence when it comes after a peripheric injury. It may be objected, however, that concussion of the brain is then its constant cause. I have not room enough to discuss the question here, but I think that the possibility of a reflex origin to mellituria is clearly established by cases like those reported by Dr. W. R. Hill, in which a burn was the cause of the secretion of sugar.[9] Cases of alteration of hair due to neuralgia or injuries of nerves are not rare, and I could easily mention many, showing changes in color, in thickness, in abundance, and in rapidity of growth of hair.[10] *Cataract and glaucoma* have been pointed out also as evidently resulting, in some cases, from an irritation of nerves.[1]

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[1] An Essay on Wasting Palsy, London, 1858.

[2] Gazette médicale de Paris, p. 687. 1847.

[3] Essai sur l'Aplasie lamineuse progressive, Paris, 1869.

[4] Archives de Médecine, juillet, 1854, pp. 311–12.

[5] Lectures on Surgical Pathology, edit. of 1853, vol. i., p. 44.

[1] The Lancet, 1826, vol. i., p. 27.

[2] The Lancet, vol. ii., 1859, p. 336; and The Brit. Med. Journ., Dec., 1866, p. 730.

[3] The cases of Sherwin and Watson are cited by Mr. Hamilton, Dublin Journal of the Med. Sc., vol. xiii., pp. 51, 54, 1838.

[4] Dublin Journal of the Med. Sc., vol. xiii., pp. 41 and 43, 1838.

[5] De l'Asphyxie locale ou gangrène symétrique des Extrémités. Paris, 1862.

[6] The Lancet, vol. xiii., p. 152, 1850.

[7] Comptes rendus de la Société de Biologie, pour 1854, p. 76.

[8] The Medical Press and Circular, Jan. 10, 1866.

[9] Beale's Archives of Medicine, vol. ii., p. 172.

[10] I found lately that in some animals the division of the sciatic nerve is almost always followed, in two or three months, by a fall of hair in the neck on the side of the lesion.

SECTION II.—GENERAL FEATURES AND RULES OF TREATMENT OF THE VARIOUS AFFECTIONS CAUSED BY AN IRRITATION OF A NERVE.

The following features usually characterize cases of neuralgia, paralysis, epilepsy, and other affections brought on by a peculiar influence, exerted upon, or through a nervous centre, by an irritation of a nerve.

1st. Previous to the appearance of a remote affection due to such an irritation, the patient has suffered for a variable time from a neuralgia or a neuritis, from a wound or a burn, or from pressure upon a nerve, by either a tumor, a displaced bone, or a foreign body.

2d. An increase or a decrease of the irritation of a nerve is often followed by corresponding changes in the intensity of the remote affections caused by the peripheric nervous irritation.

3d. The various modes of treatment of nervous and other affections, produced by an influence exerted on the nervous centres by a peripheric irritation, are generally quite unsuccessful so long as this irritation persists unabated.

4th. The various affections produced by a peripheric nervous irritation are frequently cured or relieved at once, or very soon after the removal of their cause, viz., the irritation.

I may add a few other characters, more or less implied, however, in the preceding: 1st. When remote affections due to a peripheric nervous irritation occur by fits, it is not rare to see the fit suddenly produced (completely or incompletely) when the diseased nerve is irritated by pressure, or otherwise (application of galvanism, for instance). 2d. Narcotics, applied to the diseased nerve, will very frequently diminish, at least for a time, the remote affection, even, sometimes, when it consists in, or is connected with, a notable alteration of nutrition.

The above characters may all serve for the diagnosis of remote affections caused by a peripheric nervous irritation; but the only essential one consists, of course, in the pre-existence of a lesion of a nerve. It must be remembered, that if the trunk of a nerve is inflamed, all the symptoms spontaneously mentioned by the patient may seem to him to exist only at the terminal ramifications of that nerve. There is but one way to ascertain what the starting-point of these symptoms is: it consists in the examination, by pressure, of as much as possible of the whole length of the nerve, from the periphery to the neighborhood of the brain or spinal cord. Had this rule been applied in the following case, it would not have been published and accepted as a case of reflected influence from a disease of the nerves of the thumb upon the four limbs.

> Lady —— was attacked suddenly by an acute pain, soon followed by redness and swelling in the left thumb; and the other fingers gradually were also attacked, and afterwards the forearm. There was contracture and paralysis, with hyperæsthesia. The other arm became affected in a similar way; and when the pain was violent, there was paraplegia. No benefit was obtained from powerful narcotic applications on the left thumb and hand; but the patient was cured after the use of a counter-irritant ointment rubbed over the arm.[1] In this case there had been no injury to the hand; there was no neuralgia; and the symptoms observed in the fingers and the forearm were those we find in cases of local meningitis, or inflammation of the sheath of nerves, at their exit from the spine. I have seen five similar cases, four of which were cured by counter-irritants applied to the spine.

The wonderfully powerful and varied influence exerted by an irritation of a nerve is not due to pain, but to an action of peculiar incident non-sensitive nerve-fibres, as is well proved by two sets of facts: first, that there may be no pain, and even no sensation of any kind, in certain cases in which, however, a peripheric nervous irritation causes a neurose,[2] or another affection, as, for instance, in cases of worms in the bowels; secondly, that we every day see cases of pain from neuralgia, or other diseases of nerves, without the production of any remote affection. In only few cases seen by myself or others, was there such an agonizing pain as in a patient, in whom a ball had lodged in the trunk of the radial nerve, producing for many days the most excruciating pain, depriving him of sleep, and causing a continued perspiration from his face, without any other marked reflex action than a contraction of the forearm upon the arm.[3]

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[1] Gazette des Hôpitaux. 1846, p. 1; Gazette Méd. de Paris, 1840, p. 130, and 1845, p. 546; and De Brondeau's dissertation, Des Affect. sympath. de l'un des Yeux à la suite d'une blessure de l'autre œil, pp. 40–46. Paris, 1858.

[1] Case of Pearson, in Med.-Chir. Trans., vol. viii., p. 252 et seq. Pearson does not speak of the spine. Had he examined it, he would have found great tenderness between the shoulders and a little above.

[2] See my Researches on Epilepsy, p. 17. Boston, 1857.

[3] Case of Denmark, in Med.-Chir. Trans.,

It may seem quite surprising, and perhaps incredible, that the same cause, viz., an irritation of a nerve, will either produce no effect at all, or produce such a variety of affections as I attribute to such a cause. But those who will take the trouble of studying the variety of effects of a clear cause of reflex action, such as, for instance, the exposure of many people to a cold wind when they come out perspiring from a very warm room, will understand that reflex effects may be exceedingly various, although resulting from the same peripheric cause.

Treatment.—Of the various means of treatment of the reflex and other remote effects of the irritation of a nerve, the most important may be classed into two groups—the local and the general means. As regards the local means, they consist chiefly in applications of revulsives or sedatives, or in an amputation, or division of a nerve; while the general means consist chiefly in the use of remedies that will diminish the reflex power, or the morbid excitability of the irritated nerve.

Local means of treatment.—Of these means, the best theoretically are also the best practically, according to the mass of facts I have collected. The section of the injured or irritated nerve between the brain or spinal cord and the part of the nerve which is altered, is certainly the most important local means. I hardly need to say, that if this operation is to be performed, the sooner the better, in cases of hydrophobia, epilepsy, tetanus, reflex neuralgia, paralysis, etc. Of course, if there is any reason to fear that the irritating cause will persist after the time necessary for the reunion of the parts of the divided nerve, an excision of an inch or two, which will retard reunion, must be made instead of a simple division. There is no doubt that in a number of cases (especially those of long duration) this operation will not succeed; and there are many discouraging facts, showing that the alteration of nutrition produced at a remote distance from the irritated nerve will continue after the division of the nerve, owing to causes yet undiscovered, or to an inflammation of the nerve in a great length between the place of the section and the nervous centres. It would be prudent always to excise at least a very small part of the length of the nerve, to ascertain, by a microscopical examination, if it is inflamed at the place of the operation; as, if such be the case, another division ought to be performed much higher up, and even as near the nervous centre as safely possible. In a paper recently published by M. Arloing and M. Tripier,[1] they give good reasons for the division of all the nerves of a limb in cases of tetanus; but I do not think that this radical proceeding is essential in a large proportion of cases of tetanus.[2] Still less would it be essential in most other affections due to the peripheric irritation.

There are cases in which, instead of dividing a nerve, all that is necessary is to gain a few days to allow a wound to heal up. I proposed, several years ago, to make use, in those cases, of a simple means, consisting in laying bare the nerve above the wound, and in dropping sulphuric ether upon it. This operation, especially if ether is often applied, may render the nerve, for many days, quite unable to transmit any irritation from the original wound.

Amputation of a limb should never be resorted to with the view of curing reflex epilepsy, tetanus, etc., unless, of course, this operation happens to be necessary for another purpose.

In hydrophobia, besides the section of the nerve at a notable distance from the wound, it would be prudent, after a double section, to withdraw the whole length of the nerve from the place of the upper section to the place of the lower one, which should be near or below the original wound (*i. e.*, the bitten part).

Subcutaneous injections of narcotics just above the wound, or on the irritated nerve, together with applications of emollient and narcotic lotions, or poultices, on the wound itself, are among the best local means for neurotomy. I have sometimes obtained the cure of chorea, of irregular attacks of convulsions, of *reflected* neuralgia, and even twice of epilepsy, by subcutaneous injections of narcotics (from half to two-thirds of a grain of morphia, together with from one-sixtieth to one-twenty-fifth of a grain of atropine.)

I have derived some benefit also in cases of epilepsy with a distinct peripheric aura, from applications of temporary circular blisters, like a ring, around a limb or a finger.

Applications of ice, or even sometimes of a freezing mixture, on the spot where a nerve is wounded or irritated, might be sufficient to produce a cessation of its influence on the nervous centre or another

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1813, vol. iv., p. 48. The patient was cured by the amputation of the arm.

[1] Archives de Physiol. normale et pathol., p. 245, 1870.

[2] While correcting the proof of this article I received a number of the Boston Medical and Surgical Journal (March 31, 1870, p. 238), in which I find a case of severe traumatic tetanus, cured by exsection of the internal plantar nerve. Dr. G. E. Foster, who reports the case, states that "no spasm of any kind" occurred after the operation.

organ. Induction of local anæsthesia by applications of ether spray just upon and above the wound might also be employed with benefit. Before dividing a large nerve, or several nerves, one of these means should be tried.

The actual cautery, applied at white heat, may also be extremely useful. It is perhaps the best, and one of the least painful counter-irritant means.

I need not say that foreign bodies, tumors (neuromatous and others), or vicious cicatrices, etc., giving rise to reflex affections, should be extirpated.

General means of treatment.—After anæsthetics, the most powerful agents to subdue the reflex excitability of the nervous centres are the bromides of potassium and ammonium, belladonna, Indian hemp, aconite, hyoscyamine, ergot of rye, and turpentine; to which list now a few other substances, such as the chloride of barium, Calabar bean, and chloral can be added. It ought to be remembered that in many cases of reflex affections, the most powerful narcotics, especially opium, and also other remedies, such, for instance, as the chloride of barium, may be borne in very large doses without any poisonous effect. It would be impossible to say more as regards the general treatment without entering into details which I have not room enough to give,[1] and also because the rules must vary considerably according to the kind of reflex affection to be treated, and the special features of each case.

LOCOMOTOR ATAXY.

By J. Lockhart Clarke, M.D.

Revised by Roberts Bartholow, M.D., LL.D.,

Although locomotor ataxy comes more frequently under the care of the physician than the surgeon, yet in the early part of its course the symptoms are so equivocal, and so liable to be mistaken for those which belong to certain surgical diseases, that for the sake of the differential diagnosis alone, a short description of this malady should have a place in every system of surgery.

Among its chief peculiarities are the progressive development of the most prominent symptoms at intervals of considerable length; the irregularity with which, in the order of time, some of these symptoms make their appearance in different cases, and consequently, the different way in which they are grouped together. It is to these circumstances that we must attribute, in a great measure, the difficulty which frequently attends the differential diagnosis of this disease.

The symptoms observed in different cases on record are the following:—Strabismus, diplopia, amblyopia, amaurosis, ptosis, contraction of both pupils or only of one; shifting pains in different parts of the body, chiefly in the extremities; cutaneous and muscular anæsthesia and loss of sense of temperature; ataxy, or inco-ordination of voluntary movements; incontinence of urine and dysuria; loss of electro-muscular contractility in a greater or less degree; occasionally, but rarely, some paralysis of the first, fifth, seventh, eighth and ninth cerebral nerves; spermatorrhœa, with loss of sexual power and desire; œdematous swelling of the joints, chiefly of the knees; cardiac and gastric disturbance.

All these symptoms are never associated together in any one case of locomotor ataxy; and, as already stated, the variety of ways in which they are grouped constitutes one of the peculiarities of the disease. Thus, to give a few practical examples, the symptoms are grouped in the following way, and made their appearance in the order of time in which they are mentioned.

Case I. Strabismus and diplopia; pains in the legs, with numbness of toes; ataxy or unsteadiness of gait; numbness of fingers, followed by pains in the arms and unsteadiness of voluntary movements, or ataxy; incontinence of urine.

Case II. Great nervousness and external strabismus of right eye, weakness of both legs and of right arm; numbness in dorsum of each foot, in right hand as high as the wrist, and in joints of little and ring-fingers of the left hand; slight numbness round the mouth; pains in upper and lower extremities, and in head: ataxy; incontinence of urine and dysuria; some impairment of smell and taste; rachialgia, and griping in the bowels; loss of sexual power and desire.

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[1] I will refer for details to my work On the Diagnosis and Treatment of Functional Nervous Affections, the first part of which, treating chiefly of general therapeutics, was published in 1868.

Case III. Pains, with numbness and heaviness of legs; pains in abdomen and chest; ataxy; pains and numbness in hands and arms, followed by ataxy; analgesia; incontinence of urine and dysuria, alternately; hemorrhoids; loss of sexual power.

Case IV. Hemorrhoids, with pain and numbness in sacrum and perineum; heavy forcing pains in rectum, with tightness and weight in abdomen. Subsequently pains in legs. Both pupils contracted to size of pin's head; ataxy of movement; loss of taste and smell; impaired sensation and motion on right side of nose; great numbness of feet and legs, and analgesia; numbness of fingers; "quivering" of muscles; exalted reflex excitability of skin over feet and legs.

In many cases the pains in the limbs are for an indefinite, but sometimes for a very long period the only precursors of the other symptoms with which they are subsequently associated. They consist of two kinds—the one more or less dull, aching or gnawing, and frequently described by the patient as rheumatic; the other more acute and lancinating, like electric shocks. The former are more continuous; the latter occur suddenly, in paroxysms which last from a few hours to a few days, and as suddenly disappear for an indefinite period. Even during the paroxysm the pain is not continuous, but intermitting, although it may recur in rapid succession at very short intervals, and may either fix on some particular spot, or fly from one part to another with the rapidity of lightning. The parts which most frequently suffer are the lower and then the upper extremities. [Besides these pains some patients suffer from girdle pains. The limb feels as if embraced in a cuirass, or as if a garter were firmly tied around the leg. The band-like sensation around the body at the waist, so common in spinal diseases, is usually present in this affection. Sometimes an intense burning pain is experienced in spots, which afterwards exhibit trophic changes — become discolored, or smooth and glossy, or the epidermis exfoliates.

Anæsthetic spots and areas are sometimes affected by exquisite pain: a pin may be thrust into such spots without exciting any sensation, and yet the most intense pain may occur paroxysmally in them. The pains of this disease are much affected by atmospheric changes, are worse in winter, in damp and cold weather, and are improved by warmth and dryness, by the summer temperature; hence, the apparently rheumatic character of the pains, before other symptoms arise.]

In other instances the ocular disturbances are for a long time the only symptoms that excite attention. These consist of internal or external strabismus, or amblyopia followed by amaurosis. In more than one-half of the cases of locomotor ataxy, paralysis of either the third or the sixth cerebral nerve, with diplopia, occurs during the first stage. It not unfrequently makes its appearance quite suddenly—in a moment—on awaking in the morning, and during a state of apparent health. But the peculiarity of this affection is its periodicity. Sometimes it continues only for a few days, sometimes for weeks or months, and then disappears as suddenly as it came, to return, perhaps, at some future period. It may occur only at particular times of the day, during certain emotions, or after the eyes have been much fatigued; or it may persist uninterruptedly from the beginning to the end of the disease. Occasionally the strabismus is double, but more frequently it is limited to one eye. In other cases, where there is no perceptible strabismus, there is nevertheless diplopia or double vision, when the patient looks in some particular direction. The strabismus is not unfrequently accompanied by more or less ptosis and dilatation of the pupil. Sometimes one pupil is dilated while the other is contracted, and sometimes both pupils are reduced to a very small size, when there is no other apparent affection of the third nerve or of the other ocular nerves.

Amblyopia is occasionally one of the earliest symptoms of locomotor ataxy. It rarely disappears, or even remains stationary, but generally increases at a variable rate, and often terminates in amaurosis. [To these ocular symptoms, must be added the absence of pupillary contraction on exposure of the eye to light, whilst the normal movements of the pupil with the accommodative action are retained. Nystagmus, bilateral usually, is by no means infrequent.]

The ataxy, inco-ordination, or loss of power to control the voluntary movements, is an invariable and essential symptom, which makes its appearance in different cases at different periods of the disease. Occasionally it is first in the train of symptoms, but generally it is preceded for a variable length of time, either by the peculiar shifting pains, or by the ocular disturbances already mentioned. According to my own observations, which have been confirmed by those of other investigators, the disorderly movements occur under two different forms. First, they are generally manifested in the lower extremities, as simple unsteadiness of gait; the patient staggers or totters more or less, like a person partially intoxicated. At the same time he frequently complains of heaviness about the legs, of fatigue after walking a short distance, and particularly after standing. When he stands with his feet close together and his eyes closed, he sways about, and would certainly fall if he were not supported. Before the disorder is far advanced, he may be able to walk alone while looking straight before him, or sideways on surrounding objects; but, at a later period, he cannot move without looking at his feet. When the disorderly movements extend to the upper extremities, the patient is unable to dress himself, or button his clothes, to write, pick up a pin, or execute movements of a similar nature.

As the disease advances, another kind of disorderly movement supervenes. This is of a jerking character, and arises from spasm of the muscles, which the will puts in motion but is unable to control; for the patient has lost the power of regulating *the degree of their contraction*. Once excited by the will, the muscles contract spasmodically beyond the degree intended, and flex or extend the limb with a sudden and uncontrollable jerk.

These two kinds of inco-ordination are associated together in different degrees in different individuals; and, according to my own observations, the first kind is that which generally prevails in the early stages of the disease. At a later period, the second or spasmodic kind of disorder increases. All the voluntary movements are more or less hurried and precipitate. The patient seems to be walking upon springs; he proceeds with a kind of prancing gait, and brings his heels to the ground with a kind of kick. If he attempts to take hold of an object with his hands, he probably thrusts it from him by a spasmodic jerk of the arm. [The muscles of the neck may be affected so that the movements of the head are ataxic. In some cases the muscles concerned in speech are attacked, when stammering and other irregularities of vocalization occur. Although the muscular disorder is inco-ordination without paralysis, yet towards the end the muscles become paretic. At all periods of the ataxia, if a close examination were made, some muscular feebleness would be disclosed in many cases.

A very characteristic symptom is the absence of the tendon-reflex. The patellar tendon-reflex may be absent in a very early stage of the disease, and before the ataxia has appeared. At the period of full development of the disease, the tendon-reflex is absent in forty-eight out of forty-nine cases, according to Erb. When the legs are crossed, a smart tap on the patella or its tendon is followed, in the normal condition, by a movement of extension of the leg. In locomotor ataxy this does not occur, as a rule.

In some cases of this disease, a peculiar phenomenon is observed, called by Westphal, who first described it, paradoxical contraction. When the points of origin and insertion of a muscle are approximated, contraction of the muscle takes place. The best exhibition of the phenomenon is afforded by the contraction of the tibialis anticus, on the sudden dorsal flexion of the foot; the tendon of the muscle rises up, and the foot is kept in a state of dorsal flexion and adduction for several minutes. This is by no means peculiar to tabes dorsalis, but it is sometimes present, and may serve to confirm a wavering opinion.]

The motor ataxy is usually accompanied, and occasionally preceded, by cutaneous *anæsthesia* to a variable degree and extent. The fingers, toes, arms, and legs are the parts chiefly affected. The patient commonly feels as if he were walking upon something soft like wool; unless he looks at his feet he is not certain that they have reached the ground. Sometimes he can scarcely feel that he has any feet at all, or seems to be "walking on air," or "on his ankle-joints," or "on his hip-joints," when the numbness extends up the thighs.

Analgesia, or loss of sensibility to pain, is frequently experienced to a variable degree and extent; or painful impressions are conveyed to the sensorium with unusual slowness. In one case that I saw, three or four minutes elapsed before the patient experienced any sensation of pain in the part that had been pricked; and, in another, it was not till after the very long interval of *twenty minutes* that the patient, without being asked, complained of smarting in the part which had been pricked with a needle.

[Double sensations are experienced in some instances from the prick of a needle: touch, which may first be felt, and, some time afterward, pain. The transmission of touch, as well as of the sense of temperature, may be delayed, although to a less extent than pain. Alterations of the muscular sensibility are common. One of the most usual and distressing is the feeling of unrest commonly known as the "fidgets," which impels to constant changes of position. The muscular sense is also either impaired or destroyed, and hence the knowledge of the position of the members is defective or wanting, leading to over- or under-effort to accomplish a given movement.]

Like the strabismus, the disorders of the urinary organs are remarkable for the intermittence of their attacks. The dysuria and incontinence of urine frequently recur alternately at the same period of the disease.

Spermatorrhœa, followed by loss of sexual power, with or without loss of sexual desire, are among the early symptoms of the malady in a large majority of patients.

[An unusual salacity is one of the first symptoms observed in this disease. This is followed by increasing difficulty in satisfying the inclinations, and then nocturnal losses occur. The erections decline in vigor, and finally the sexual congress becomes impossible, and complete impotence results. Anæsthesia of the urethra occurs, and hence the flow of the urine and its cessation are not felt, and require inspection. The control of the bladder may be lost and the urine dribble away. Anæsthesia of the rectum may, also, take place, and the patient be unconscious of the passage of the feces. Usually this condition of the rectum gives occasion for much inconvenience, partly by the persistent constipation, or partly because when the inclination to go to stool comes on, control is lost at once.]

Occasionally a very remarkable joint-affection has been observed in the course of locomotor ataxy. This was first described by Dr. Charcot, of Paris. The knee-joint is almost invariably the seat of the disease, which occurs suddenly as an elastic œdematous swelling. The part is neither red nor painful, nor is there any constitutional disturbance or fever. Like the strabismus and urinary affections, it may last only a short time, or be prolonged and give rise to permanent deformities. In the latter case the bones and cartilages of the joint have been found diseased.

[The joint affection manifests itself during the first stage, and with the lightning pains. Next to the knee, the joints affected are the shoulder, the elbow, the hip, and the wrist. After the knee has been affected for some time, the joints of the upper extremity may be attacked. Luxation of the joints may ensue, and fractures, in consequence of an abnormal fragility of the bones, are not uncommon.]

At an early period of the disease, before motor ataxy has made its appearance, and when only one or perhaps two of the other symptoms are present, the differential diagnosis is exceedingly difficult. But whenever strabismus or the peculiar flying pains suddenly attack an otherwise healthy person, they should always suggest the possibility of their being the precursors of ataxy. In a large proportion of instances the strabismus is accompanied by amblyopia; and when it is single, the amblyopia is on the corresponding side.[1] Even in cases in which other symptoms have been present, and in which the diagnosis was by no means difficult, I have seen operations needlessly performed on the eye by surgeons who were ignorant of the nature of locomotor ataxy. Frequently the disease has been mistaken for incomplete paraplegia. It is not long since I was asked by a surgeon to a public institution to see a case of supposed paraplegia, which proved to be a well-marked case of locomotor ataxy.

Pathological anatomy.—In this disease the spinal cord is always altered in structure, and in one particular part. The alteration consists chiefly of a peculiar gray degeneration and disintegration of the posterior columns, of the posterior roots of the spinal nerves, of the posterior gray substance or cornua, and sometimes of the cerebral nerves. Generally the posterior columns retain their normal shape and size, in consequence of hypertrophy of the connective tissue which replaces the lost fibres. Corpora amylacea and oil-globules of different sizes are also usually abundant. It is very common to find disintegration of the extremities of the posterior cornua, and sometimes I have found the same kind of alteration in the more central parts of the gray substance. In the latter case the disease is of a mixed nature, partaking of the characters of both locomotor ataxy and ordinary spinal paralysis.

Prognosis and treatment.—The prognosis, as might be inferred from the pathological anatomy, is generally very unfavorable. It is chiefly at the first invasion of the disease that any marked benefit is to be expected from the use of remedies. Hence the importance of an early diagnosis. One of the chief objects is to protect the patient from cold and damp, and place him in an equable temperature. A good and wholesome diet, with wine or beer, is generally necessary. With regard to drugs, nitrate of silver appears to exercise the most direct or specific influence on the disease. Sometimes it not only alleviates the pains, but diminishes the inco-ordination. It should be first given in doses of one-eighth of a grain, gradually increased to one grain three times a day, after meals. To prevent it from irritating the bowels or the bladder, it may be combined with opium, with cannabis indica, or with belladonna. For relieving the severity of the limb-pains, which so frequently disturb the patient's rest, there is nothing so efficacious as the subcutaneous injection of morphia, beginning with one-sixth of a grain. I have always found these pains aggravated by constipation, and in this case I get the bowels to act by some means or other. Dry cupping along the spine sometimes affords decided relief. Sulphur-baths have occasionally been of some service. Faradization has generally been found to be rather injurious than beneficial, but the constant galvanic current has been used with the best results.[1]

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[1] Dr. Hughlings Jackson states that the amaurosis of ataxy, as regards its ophthalmoscopic appearance, is unlike the amaurosis from disease of parts within the head. In amaurosis from intracranial disease the optic disc always shows evidences of recent or past neuritis, which is not the case in ataxy.—Lancet, January 10, 1865.

[An inverse galvanic current, stabile, from ten to thirty elements, should be applied to the spine for a few minutes daily. The length of time the applications should be kept up, and the intervals of cessation of the treatment, will depend on the results. The spinal nerves and the main trunks of the peripheral nerves should have stabile and labile applications, for the relief of pain, and to remove trophic changes in the joints and elsewhere. Wasting muscles should be stimulated by the faradic current.

One of the most important advances yet made in the treatment of this disease is the surgical expedient, *nerve-stretching*, first practised by Credé, of Dresden. One or both sciatic nerves are exposed, the finger passed under it, and the nerve is then stretched, but not enough to injure its texture. In some cases lately reported the nerve appears to have been pulled on too strongly, so that various trophic affections have followed. When the requisite amount of force has been applied, and not too much, excellent results have followed—the pains have disappeared, and the ataxia has improved. A sufficient number of cases have now been published to justify the belief that this surgical expedient is a valuable means of treatment.

The persistent use of cod-liver oil has done great good in many cases. Phosphorus in minute quantity, persistently administered, is certainly only second to the nitrate of silver in curative value. It may be advantageously administered in cod-liver oil. The chloride of gold has seemed to the writer to be very beneficial in some cases. In those examples of the disease due to gummata, or to the imbibition of metallic poisons, the iodide of potassium renders an incontestable service.

The rest-cure has been applied successfully to the treatment of *recent* cases. This consists in as nearly absolute repose of the body in a recumbent posture as can be attained. From one to three months of entire rest may be required. With rest may be conjoined massage, inunctions of oil, and faradic excitation of the muscles.]

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[1] For further information on this subject, see Trousseau's Clinical Medicine; Duchenne's Électrisation localisée; and my own articles in vol. i. of St. George's Hospital Reports, and British Medical Journal, 1869.

PART IV.

GUNSHOT WOUNDS.

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GUNSHOT WOUNDS.

By Thomas Longmore, C.B., F.R.C.S.

Revised by Hunter McGuire, M.D.

Gunshot wounds consist of injuries from missiles projected by the force of explosion. As the name implies, this class of wounds is ordinarily restricted to injuries resulting from fire-arms; but it should be remembered, that wounds possessing the same leading characteristics may result from objects impelled by any sudden expansive force of sufficient violence. The fragments of closed vessels burst asunder by the elastic power of steam, will inflict wounds of precisely the same nature as those caused by the bursting of a shell. Injuries from stones in the process of blasting rocks offer familiar examples of wounds of a like nature. In the following pages, however, gunshot wounds will be considered as they are met with in the operations of warfare.

History.

From the earliest time of the application of gunpowder to implements of war, down to the present day, the wounds inflicted by its means have excited the most marked interest among surgeons; nor can this be wondered at, when the immensely superior energy of this agent in comparison with all the mechanical powers previously in use for hostile purposes, and the terrible nature of its effects on the human frame, are remembered. By its introduction the whole aspect of war was changed, in a great degree, by the distance at which opposing forces were enabled to contend with each other; just as, in our day, the nature of battle is undergoing another change from the increased range and precision of fire obtained through the general use of rifled weapons. But though the alterations now being made in the qualities of fire-arms are of the utmost importance to those whose business and especial study is the art of war, to the army surgeon the interest they excite is chiefly limited to the degree of injury and destruction inflicted by them as compared with weapons of a less perfect kind; while, to the surgeons employed at the time of the introduction of gunpowder, the wounds were wholly new in their nature as well as degree. Recollecting the ignorance which then prevailed in all departments of science and art, it can excite no surprise that the new engines of war, with the flame and noise accompanying their discharge, were regarded with superstitious terror; nor that surgeons for a long time found an explanation of the sloughing severity of the injuries they inflicted, and of their difficult cure, in the poisonous nature of gunpowder, or in the burning effects of the projectiles from heat acquired in their rapid flight through the air. Unfortunately, these erroneous views did not end with the theories from which they started, but led to treatment which only aggravated the evils inflicted by the new weapons, and interrupted the progress of the healing action which nature would otherwise have established. The wound being regarded as a poisoned wound, it was believed that the poison could only be got rid of by a long and tedious process of local suppuration, and so prevented from entering the system of the patient. The irritative fever, the wasting and emaciation, and all the other results of the protracted cure of the injury, were pointed to as so many evidences of the indirect effect of the poison working in the frame; just as the constitutional shock at the time of the wound, the loss of vitality along the surface in the track of a small projectile, or of the tissues laid bare by the passage of the cannon-ball, were regarded as evidences of its direct influence. On looking back at the works of successive writers on this class of injuries, the reader is surprised that the improvement in their treatment has been so gradual and slow; and cannot fail to observe that the chief impediment to a more rapid amelioration of the system pursued has been the prevailing idea of the necessity of delaying the tendency of nature to close the wound, in order that the supposed poison might be eliminated from the constitution. The openings of entrance and exit, and track of the ball, were incised; the wound dilated by tents or other means, and terebinthinates, or even boiling oil, poured into it; irritating compounds and ointments applied where superficial dressings were practicable; and it was only after the wound was considered to be fully purged of its venom and foul humors by the extensive suppurative action thus kept up, that cicatrization was permitted to be established.

It required long years of observation in many conflicts, and the exercise of much industry, not to mention moral courage in opposing authorized custom and prejudice, before a simpler and more rational mode of practice was followed. It is satisfactory to know, that though continental surgeons have written more voluminously on the subject of gunshot wounds, the older English military surgeons and writers stand forth conspicuously in leading the way to a more practical knowledge of their nature and proper treatment.

Although, however, much that was erroneous was removed by the earlier surgeons, the light of science can hardly be said to have penetrated this important province of military surgery until the great and last work of John Hunter, on the Blood, Inflammation, and Gunshot Wounds, was published in 1794. This distinguished philosopher served as a surgeon on the staff of the army in the expedition against Belleisle, in 1760, and in the same capacity in Portugal in 1763. He subsequently filled some of the highest positions in the medical department of the British service: having been appointed in 1776 Surgeon Extraordinary to the Army, in 1786 Deputy Surgeon-General, and in 1791 Surgeon-General—a laborious office, corresponding with that of the Director-General, under existing arrangements.[1] The physiological principles which John Hunter enunciated, based on extensive study and observation in civil life, cannot be controverted; but their practical application, so far as regards the treatment of gunshot wounds, has been greatly modified since his treatise on the subject was published. There cannot be a better illustration of the special position in which this department of military surgery is placed, from the peculiar circumstances under which it is practised, than the fact, that though men of the highest mental attainments have discussed the subject of gunshot wounds, we are nevertheless indebted to practical experience in military campaigns for every improvement, some few of recent date excepted, that has occurred in their treatment. Thus, John Hunter was led to advocate very strongly the delay of amputation, after severe gunshot wounds, for weeks, that the patient's constitution might accommodate itself to the injury; while more extended observation has demonstrated that such secondary amputations are more fatal than those which are performed shortly after the infliction of the wounds leading to them—the advantage of the patient thus coinciding with what must very constantly happen to be a practice of necessity in the field. Mr. Guthrie remarks, in his Commentaries on the Surgery of the Peninsular War between 1808 and 1815, that the surgical principles and the practice which prevailed at the commencement of the war were superseded on almost all important points at its conclusion; and he quotes a remark of Sir Astley Cooper, to the effect, that the art of surgery received from the practical experience of that war an impulse and improvement unknown to it before.

The still more recent military operations in Algeria, in Schleswig-Holstein, in the Crimea, and in India, have afforded the opportunity of testing practically the applicability to army practice of some of the great improvements which have been accomplished in the civil practice of surgery in Europe since the termination of the war in 1815. Among these may be particularly enumerated, the avoidance of amputation of limbs by recourse to excision of joints; resections of injured portions of the shafts of long bones; mitigated amputations, by removal only of those terminal portions of the extremities which had been destroyed by the original injury; and the practice generally, of what has been styled conservative surgery. In these wars, too, the value of chloroform as an anæsthetic agent in military surgery has been fully established. They have also especially illustrated the influence of various states of health and climates on the results of gunshot wounds. All the anticipations which were held out at the commencement of some of these campaigns have not been realized, but still they have added much valuable information and many improvements to military surgery.

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[1] John Hunter held this office during the early part of the war with France which preceded the peace of Amiens. After Hunter's death the direction ceased to be vested in an individual, and, instead, an Army Medical Board was constituted, consisting of a Physician-General, Surgeon-General, and Inspector-General of Hospitals.

The alterations made during late years in the arms of the greater proportion of the troops of the leading powers of Europe, namely, the transformation of muskets into "*armes de précision*," with rifled barrels and graduated aims, have led to changes in the severity and almost in the nature of gunshot wounds from small balls; and the results of these changes require the especial attention of army surgeons. The effects of the new rifle-balls were widely witnessed during a portion of the period of the Crimean war. They were seen in still greater proportion during the campaign of 1859 in Italy, and additional practical observations have been published by the continental surgeons engaged in it. The fearful numbers of killed and wounded, greater than in any former experience, owing to the large masses of troops brought into collision with each other, exhibited the effects not only of rifled muskets, but of rifled cannon also; and, in the French forces engaged, an opportunity was afforded of instituting a comparison of the results of their treatment under circumstances of bodily health, and hospital accommodation very different from those of the French army in the Crimea.

The war of the rebellion in the United States has again largely added to our experience in gunshot wounds from rifled weapons. In England, one valuable result which emanated from the war with Russia was, the regular collection and arrangement under Government authority, for the first time, of the observations and practice of the medical officers employed in the campaign.[1] The Government of the United States has followed the same course. An official department, thoroughly and very extensively organized, under the direction of the Surgeon-General, is now carefully arranging full reports, both statistical and professional, on the injuries of the war and their results. Specimens to illustrate the pathology of wounds were collected while the war was in progress, and a large museum illustrative of military surgery in all its branches now exists at Washington.

During the year 1864, we had nearer home the war carried on in Schleswig and Holstein, and during 1866 the short but decisive war between Prussia and Austria. In the former war, for the first time, all the troops were armed without exception with rifled weapons. In the recent campaign in Germany the effects of breech-loading arms were witnessed, and since that date the change of muzzle-loaders into breech-loaders either has been made or is being made in all the armies of Europe. The rapid and uninterrupted fire that can be kept up by breech-loaders, and consequently their influence on the *number* of wounds produced within given limits of time, will probably be found to be the chief points of interest to military surgeons: it does not appear likely that the characters or any of the particular features of the wounds themselves will be influenced by the change.

One result of the system of breech-loading is, that it enables detonating and explosive bullets to be discharged from small fire-arms without danger to the marksmen handling the weapons. Dr. Scrive, in his *History of the Eastern Campaign*, states that explosive bullets were employed by the Russians in the Crimea. They consisted of small cylinders of copper containing a detonating composition, and were made up in the form of ordinary cartridges, suitable for being discharged from muskets. On hitting objects these projectiles burst with great violence. Some specimens of these explosive balls were found in Sebastopol after the conclusion of the siege, and it was only then, M. Scrive remarks, that a key was obtained to some wounds of a frightful character, which could not be accounted for by the action of ordinary bullets, or of fragments of shell.[1] No similar observation is recorded in the British official surgical history of the war; but a recent writer in the Times newspaper has referred to the fact of some English troopers having been wounded by explosive bullets at the action of Balaklava.[2] They could have been employed only to a very limited extent, however, during the Crimean war, owing to the nature of the weapons with which the Russian troops were then armed; while now with breech-loading arms they can be used, if considered advisable, without any limit.

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[1] The French statistics of the Crimean war have now been completed by the admirable work of Dr. Chenu (Rapport sur les résultats du service médico-chirurgical aux ambulances de la Crimée, par J. C. Chenu, etc., pp. 732, 4to; Paris, 1865); and there is every reason to expect even still more accurate information regarding the results of the Italian campaign of 1859, and the French campaigns in Mexico and Cochin China before long, from the labors of the same indefatigable statist. It is hoped that equally correct information will in a short time be available respecting the Prussian campaign of 1866.

[1] Relation médico-chirurgicale de la campagne d'Orient, par le Dr. Scrive, etc., pp. 438. Paris, 1857.

[2] See a letter signed F.R.C.S. in the Times of December 16, 1868. It is a curious fact, as this correspondent remarked, that the Russians who first made use of explosive bullets in war should be the first nation to propose the abandonment of such projectiles.

As, however, it has been announced that the principal European Powers, on the proposal of the Russian Government, have come to an agreement not to employ explosive rifle-balls in future warfare, the effect of such missiles as regards the wounds inflicted by them hardly needs further reference here.

QUALITIES OF THE PROJECTILES BY WHICH GUNSHOT WOUNDS ARE PRODUCED.

As gunshot wounds in war are greatly modified in their appearances, symptoms, and gravity by the varieties of missiles which produce them, some remarks on the missiles themselves and their qualities are rendered necessary. There is not space in a limited article like the present for entering fully into this part of the subject, but such leading points as the kinds of projectiles by which they are usually caused, with the influence of their form, weight, and of the varying degrees of velocity impressed upon them, will now be briefly considered.

Kinds of projectiles.—The projectiles used in warfare of the present day are, cannon- and musket-shot, shells of various kinds, hand-grenades, case-shot, and other minor varieties of such missiles. These are the ordinary instruments of *direct* gunshot wounds in warfare; but in addition, there are numerous sources of *indirect* wounds, resulting from the discharge of cannon and musketry. These are stones or other hard substances struck from parapets or from the surface of the ground by cannon-shot; splinters of wood from platforms and frame-work, or of iron from gun-carriages; fragments of bone from wounded comrades, or articles in their possession; and any other miscellaneous objects which may happen to come into contact with the solid ball, or shell, in its course,

A gunshot wound, whether received from a direct or indirect projectile, may be complicated by the entrance of secondary extraneous bodies of various kinds; most commonly, portions of the cloth or other parts of the dress worn by the person wounded. Such accompaniments of the primary projectiles often have a special bearing on the progress of cure of wounds.

Forms of projectiles.—The projectiles above enumerated present several varieties of forms. The chief are: 1. Spherical—as cannon-balls, grape, musket and pistol shot, and shells; 2. Cylindro-conoidal—as balls belonging to rifled cannon and rifled muskets; 3. Irregular, but generally bounded by linear and jagged edges—as fragments of shells and splinters.

In the largest kinds of balls, such as are projected from field pieces, or guns of position, the form offers little subject for consideration to the surgeon. So long as there is momentum enough to carry forward the mass of iron of which these missiles are composed, so long will their weight be the most important ingredient in the production of the wounds inflicted by them. But with regard to musket-shot, the form presents several features worth the consideration of military surgeons. In discussing the subject, however, it must not be omitted to be borne in mind, that we have no experience of the effects of round musket-balls propelled with the same amount of force as recent improvements in fire-arms have given to balls furnished with a conical vertex; although, in the old two-grooved rifle, with its belted round ball, a momentum was procured far exceeding that of the common smooth-bore musket. The change in form from the round to the prolonged cylindro-conoidal ball seems to derive its chief importance in surgery from the conical end possessing the mechanical characteristic of a wedge, while the former acted simply as an obtuse body. From this quality the power of penetration of conical bullets is greater, independent of the increased momentum communicated to them by the construction of the weapons from which they are discharged. Thus, supposing one of the old musket-bullets to strike a limb at 80 yards, and an Enfield rifle conical bullet of the same weight at 800 yards, the rate of velocity being similar in each case, the injury from the latter may be expected to be considerably greater than that from the former, on account of its shape. The wedge-like quality of the conical bullet is rendered particularly obvious on its being driven into the shafts of the long bones of the extremities. The solid osseous texture of which the cylindrical portion of these bones is composed, is split up into fragments, having mainly a direction parallel with the central cavity; and fissures not unfrequently extend from the seat of injury to their terminations in the joints, of which they form component parts. Such results were scarcely ever noticed from the impact of round balls. The bone might be comminuted, but the fragments were of a more cuboid shape, and the long fissuring did not usually occur.

The same difference of effect may be observed on comparing the injury produced upon the apophysis of a bone by a conoidal bullet with that produced by a round ball. The splintering caused by the conoidal projectile will generally be found to extend to a considerable distance into the shaft, while the injury from the round one is usually limited to the apophysis itself. This difference becomes of practical importance when the subject of the treatment of such an injury by resection is considered; not only as regards the extent of bone necessary to be removed, but also as regards the progress of cure and the general results of the operation.

Fig. 746.

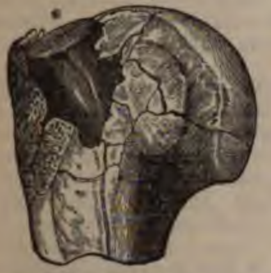


Fig. 747.

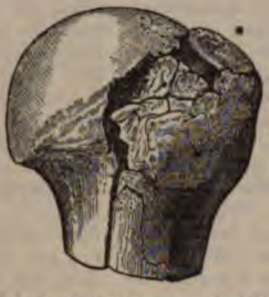
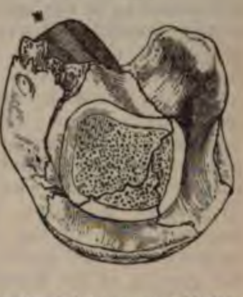


Fig. 748.



Figs. 746 and 747 show the condition of the head of a humerus, which has been struck by a *conoidal* ball at the anterior aspect of the greater tuberosity. The bullet (shown by the asterisk *) has entered apex first, and is imbedded in the cancellous tissue, its base being on a level with the surface of the bone. Great splintering has followed, and fig. 748 shows the fissured condition of the shaft, at the part where the operation of resection has been performed. It is probable that these fissures extended some distance in the shaft below the line of resection.

The following drawings of two shoulder-joint wounds (figs. 746, 747, 748, 749, 750, 751), one caused by a round, the other by a conoidal bullet, during the Crimean campaign, well illustrate the relative effects just described. They are the more interesting as regards the question of the influence of *form*, inasmuch as in each case the same part of the bone has been struck, and the momentum, or force, of the two projectiles has been also alike, as evidenced by their corresponding depth of penetration. The sketches are taken from specimens in the Museum of the Royal College of Surgeons of England.[1]

Fig. 749.

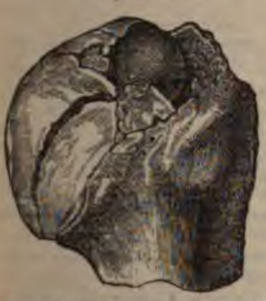


Fig. 750.

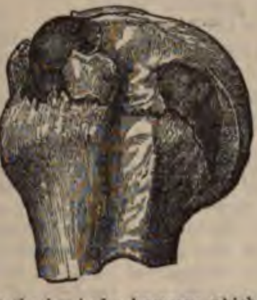
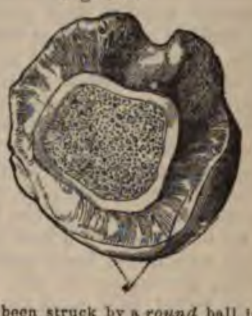


Fig. 751.



Figs. 749 and 750 show the condition of the head of a humerus which has been struck by a *round* ball in nearly the identical spot at which the specimen represented in figs. 746, 747, and 748 had been struck. The round ball, like the conoidal, has also entered to a distance corresponding with its own depth, its surface being on a level with that of the surrounding bone. Although the head of the bone has been greatly shattered, as shown in fig. 749, the rending asunder, or splintering, is very limited, and the saw, in resecting the injured head, has passed through the shaft (see fig. 751) without crossing a single fissure; and this, notwithstanding the operation has been performed somewhat nearer to the neck of the bone than in the preceding instance.

Another result of the tapering form of the conical bullet is, that it is less exposed in its course through soft parts of the body to opposition from tendons, and other long and elastic structures, so frequently noticed to stay the progress of spherical shot. If not dividing them by direct impingement, it readily turns them aside; and it is partly due to this pointed shape, therefore, as well as to increased force, that, as will be noticed hereafter, the lodgment of balls is now so rare in comparison with the experience of former wars.

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[1] Preps. No. 2926 B, and No. 2926 D. For histories of the cases, see Descriptive Catalogue of the Pathological Specimens in the Museum of the Royal College of Surgeons of England, pp. 92, 93.

Weight of projectiles.—Much has been written on the comparative surgical effects of bullets of various weights and sizes; but these qualities do not, on consideration, excite so much practical interest in the mind of the surgeon as it might at first appear they are calculated to do. Some very heavy bullets were used by the Russians in the defence of Sebastopol, nearly one-third heavier than any employed by the troops opposed to them. Such bullets, if of like form and density, and propelled with equal velocity, would obviously inflict injuries, especially against osseous structures, which offer great resistance, wider in proportion to their greater size and momentum; but in respect to simple flesh wounds, the increased size of the wound left by the larger ball would make little difference in the gravity of the wound, or the time required for its cure, while the escape of foreign substances, which it might happen to carry with it, would be facilitated by the freer means of exit and increased discharge from the surface. Mr. Guthrie mentions, that having had a wide field for observation in the effects of the heavy British musket-balls, sixteen to the pound, on the French wounded, he did not think them more mischievous in their results than the French musket-balls, twenty to the pound, on the English soldiers; while the advantages of carrying a lighter musket and greater number of rounds of ammunition were on the side of our adversaries. It is understood that in warfare the object is not so much to destroy life as to disable antagonists, and the smaller size has been supposed to be fully equal to this object by the British military authorities of the present day. When the Enfield rifle was given to the army, the weight of the ball was reduced two drachms and a half below that of the ball which had been used with the Minié rifle, previously in use. The weight of the bullet used with the Minié rifle was 680 grains; with the muzzle-loading Enfield it was reduced to 530 grains. The bullet of the present converted Enfield breech-loader is still less in weight, being only 480 grains. This projectile is destined to be still further reduced in bulk, as combatants find the bore of the Enfield rifle to be needlessly large. Its diameter is one-tenth of an inch greater than that of the French Chassepot rifle, and the bullet used with it, as well as the cartridge, is considerably heavier; hence a French soldier can now carry 135 rounds to an English soldier's 90 rounds—a military advantage which, it might be supposed, would not be allowed to continue. But it does not appear likely that the contemplated new projectile, though less in diameter, will be less in weight than that of the present breech-loading Enfield; indeed, the bullet most recently recommended for adoption has precisely the same weight, viz., 480 grains.[1] After all, however, within the moderate limits which must be preserved to suit the circumstances of infantry soldiers, the form, hardness, and velocity of musket-balls must be the qualities of interest to the surgeon in connection with the wounds inflicted by them, rather than their relative weight.

Course of balls.—Another influence resulting from the form and average momentum of modern small-arms projectiles may be noticed. Of the circuitous and unexpected directions pursued by bullets in their passage through the human frame, which were formerly so common, we are not likely to see many instances now that the rifle is the weapon chiefly employed. The conoidal shape of the ball, and the force with which it is propelled, have had the effect, among others already named, of changing the indirect and tortuous course which was so characteristic of the ball from the smooth-bored musket. The latter, bearing a force that scarcely carried it true to a mark at eighty yards, and receiving, as it left the firelock, an impulse which caused it to revolve on its axis at right angles with the line of flight, was deflected by the most trifling obliquity of surface, by the resisting obstacle of a bone, by tendons, or the aponeuroses of muscles, or even by the elastic resilience of muscles themselves in a state of action, when the relative direction of their fibres was favorably placed to exert this influence. The Enfield cylindro-conoidal bullet, armed with a force that will carry it to a given spot distant 1000 yards or upwards, flies spinning on an axis coincident with its line of flight, penetrates the softer tissues in a straight line, and on meeting bone, as before noticed, enters it like a wedge. When a bullet of this kind strikes an object point blank, it is always the apex of the conical part which first meets the object struck; and, if sufficient resistance be met with, it is this apex which becomes first compressed, and turned back. When it strikes a solid object lying nearly parallel with its line of flight, the ball is planed, as it were, from its apex towards its base.

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[1] The bullet recommended by the Small Arms Committee for adoption with the Martini-Henry rifle, with which it is proposed to arm the British infantry, instead of the converted Enfield rifle, is without the hollow base, baked clay plug, and wooden plug in the head, which are features of the bullet in present use. It is, instead, solid and wholly made of lead hardened with tin; and hence, though only .45 of an inch at its widest part in diameter, instead of .55 of an inch as the Enfield, it is not reduced in weight. The weight of the French Chassepôt bullet is 24.50 grammes, or a fraction over 378 grains, and is therefore 102 grains lighter than the Enfield bullet and than the newly recommended Martini-Henry bullet. The combatant advantages connected with the lightness of the Chassepôt ammunition are stated to be outweighed by the following advantages on the side of the Martini-Henry weapon and its projectile: greater accuracy of flight, longer range, flatter trajectory, higher penetrative power, increased rapidity of fire, and certain other advantages which need not be mentioned here, as they appertain to the rifle itself rather than to the qualities of the bullet projected by it, and therefore do not influence either the number or nature of the wounds that may be caused by the weapon.

It will often appear, at first examination, that the track of a cylindro-conoidal bullet, even at full speed, is widely removed from a straight line, especially when this class of injuries is new to the surgeon. But it usually is not difficult to reconcile the apparent irregularity in the course the projectile has taken, if the many varied positions in which the body and its parts are liable to be placed are called to mind, and if, when making the examination, the surgeon takes care to place the patient in a similar posture to that he was in when struck. A certain allowance must also be made for the spasmodic actions of the various muscles among themselves, and the momentary displacement of other structures, at the instant the injury is received.

Degree of velocity.—The velocity of motion of projectiles is an important ingredient in the consideration of the wounds produced by them.

The effects of different rates of velocity on wounds are seen in the variations which occur in proportion to the distance which the missile has travelled before inflicting the injury. A cannon-ball which, with but slight velocity of motion added to its weight, would knock a man over, at ordinary speed will carry away a limb without disturbing the general equilibrium of the body. A musket-ball that would be arrested half-way through a limb, is now replaced by a ball, which, at like distance from the point of discharge, will pass through several bodies in succession.

The increased velocity, or, in other words, greater force, of modern projectiles, exhibits its effects in two directions: locally, by the greater destruction of the tissues in the track of the projectile; and constitutionally, by greater disturbance to the nerve-force of the whole system. The component parts of that portion of the organized fabric through which a bullet, travelling at the rate of several miles per minute, cleaves its way, are inevitably deprived of their vitality. Instances are quoted by authors, of gunshot wounds having healed by simple adhesion; but such examples are not met with when rifle-bullets retaining their original form have made an opening through a part of the body. Bullets which have happened to be brought into collision with stones or other hard substances on the ground before striking a soldier, and which, in consequence, have not only been deprived of part of their force, but have also been flattened into a mass with thin sharp edges, occasionally cause superficial wounds, which may readily be caused to heal by first intention, but these are essentially different from the wounds produced by rifle projectiles under ordinary circumstances.

The splitting and destructive effects of conical balls on the shafts of the long bones of the extremities have already been mentioned when referring to the peculiarities of their shape. But, together with the quality of shape, the amount of momentum is a necessary ingredient in estimating this result. The old round balls—partly from their form, but also from the imperfect mechanism of the firelocks from which they were discharged, and consequent minor degree of velocity imparted to them—on striking bones, would simply be turned away from the direct line: or, failing this, would knock out a portion of the shaft without further fracture; or, having perforated on one side, remain in the cancellated structure; or be simply flattened without penetrating. It seems not unlikely, also, that the modern conical bullets are denser, from the circumstance of their manufacture by mechanical pressure, than bullets which have been cast in moulds. The influence of density with respect to power of penetration is very great. In comparing the two most perfect of modern English rifles which have been employed hitherto, the Enfield and the Whitworth, the projectiles and charges being of the same weight, when lead is used, the penetration at 800 yards is one-third greater with the Whitworth than with the Enfield; but when a less yielding projectile is used with the Whitworth (as when the lead is mixed with tin), its penetration is more than four times greater than that of the Enfield. Whether this cause operates or not, the fact is certain that conical balls at their average speed exhibit an overpowering force over all the structures, bone included, with which they come into contact in the human body, are comparatively rarely met with flattened, or so much altered in form as round bullets were formerly under like circumstances.

Spent balls.—In connection with degree of velocity the subject naturally occurs of what are called "spent balls;" or large projectiles moving at low rates of speed. After a cannon-ball has ceased to pursue its course through the air, or to proceed by ricochet, it not unfrequently travels to a considerable distance, rolling along the surface of the ground. When its rate of movement is not much faster than that at which a man can walk, and when to all appearance it might be stopped by the pressure of the foot as readily as a cricket-ball, it yet possesses the power of inflicting serious injury on such an attempt being put into execution. This power is easily understood, if the amount of force is remembered which must still be inherent in the cannon-ball for it to overcome the inertia of its own mass, and the resistance to which it is exposed in passing over the ground on which it is rolling. It is this force, multiplied by the weight of the ball, which gives it the destructive power. If such a ball is brought into collision with the foot of a person, destruction generally ensues to such an extent as to necessitate amputation. Should it impinge on other parts of the body, as in the instance of a man lying on the ground, it may cause fatal rupture of internal organs, and that without exhibiting external evidence of the amount of injury it has inflicted. So also, though powerless to carry away a limb, it may still cause comminuted fractures of bones and extensive contusions of the softer structures.

Lodgment of balls.—Low rate of velocity leads to musket and other balls lodging in various parts of the body. When the smooth-bore musket was in common use, lodgment of balls was of frequent occurrence. In the first place, from absence of sufficient velocity to effect its passage out of the body, and secondly, from its liability to be diverted from a direct line, a round ball might be arrested in its progress at any distance from its point of entrance. Conical balls lodge when their velocity has become nearly expended before entering the body; or, from peculiarity in the posture of the person wounded, a ball having had force enough to traverse a limb, may afterwards enter into another part of the body, and lodge. A ball may reach a part so deep, in the muscles of the back, for example, or be so far removed from the aperture of entrance, as to elude all attempts on the part of the surgeon, at the time of examination of the wound, to discover its retreat. Or it may have reached some position from which the surgeon fears to take the necessary steps for its extrication, judging the additional injury that would thus be inflicted more mischievous than the probable effects of allowing the ball to remain lodged.

Unextracted balls lead to consequences varying according to the site of lodgment and state of constitution of the patient. If the ball have become fixed in the body of a muscle, or in its cellular connections, adhesive inflammation may be established around it, and, in time, a dense sac be thus formed, in which the ball may remain without causing any, or but very slight, inconvenience. But although encysted, a ball may press upon nerves and give rise to pain and much uneasiness; or it may change the position of its first lodgment, under the effect of gravitation, or the impulse of muscular actions, and may then become so placed as to embarrass the person in certain movements of the body. Sometimes the lodged projectile will not become provided with a protecting envelope of the kind above named, but will excite continued irritation and give rise to chronic abscess; sometimes the abscess will become healed, but will reopen from time to time under the influence of various exciting causes; and these cases usually end, though it may be years after the date of the original injury, by the bullet appearing so near the surface that there ceases to be any difficulty in its removal.

SYMPTOMS OF GUNSHOT WOUNDS.

Having considered some of the leading qualities of the projectiles by which gunshot wounds are produced, it is now necessary to notice some of the characteristic features and symptoms of the wounds themselves.

The chief diagnostic marks of these injuries in their early condition are those external appearances which result from the physical effects produced locally by the stroke of the projectile. Other symptoms result from injury done by the projectile in its course through the deeper tissues; such as pain, numbness, paralysis, from lesion of nerves; hemorrhage, from lesion of bloodvessels; together with particular symptoms characteristic of special organs which may have chanced to be wounded by the projectile during its passage. One general symptom, designated "shock," and indicative of constitutional disturbance, is a usual accompaniment of all gunshot wounds, but the extent to which it is exhibited varies greatly in different cases.

External signs.—The external distinguishing signs of a penetrating gunshot wound are generally manifest enough. But, although possessing certain universal characteristics, they vary so much, according to the differences already described in the forms of the missiles causing the injuries, their velocity, the part of the body struck, and the position of the patient relative to the projectile at the time of injury, that it is necessary shortly to describe some of these variations.

When a cannon-ball at full speed strikes in direct line a part of the body, it carries away all before it. If the head, chest, or abdomen are exposed to the shot, an opening corresponding with the size of the ball is effected, the contiguous viscera are scattered, and of course life is at once extinguished. If it be part of one of the extremities which is thus removed, the end remaining attached to the body presents a stump with a nearly level surface of darkly contused, almost pulpified, tissues. The skin and muscles do not retract as they would had they been divided by incision. Minute particles of bone will be found among the soft tissues on one side, but the portion of the shaft of the bone remaining *in sitû* is probably entire.

In a ricochet shot, or in any case where the force of the cannon-ball is partly expended, the extremity, or portion of the trunk, may be equally carried away, but the laceration of the remaining parts of the body will be greater. The surface of the wound will be less even. Muscles will be separated from each other, and hang loosely, offering at their divided ends little appearance of vitality; spiculæ of bone of larger size will probably be found among them; and the shaft may be found shattered and split far above the line of its transverse division. The injury to nerves and vessels may be proportionately higher and greater. Occasionally it happens, even where the limb seems to have been struck in direct line, that it is nevertheless not completely detached, but remains connected by shreds of the skin and parts of the tissues jammed together, on which the bone, reduced to minute fragments, is mixed with the contused muscles and other soft parts in a shapeless mass.

If the speed be still further diminished, so that the projectile becomes what has been explained to be a "spent ball," there will not be removal of the part of the body struck, but the external appearances will be limited usually to contusion and laceration of the soft parts, or extensive ecchymosis and tumefaction without division of surface.

Should the cannon-ball strike in a slanting direction, the external appearances of the wound will be similar to those just described, according to its velocity, modified only in extent by the degree of obliquity with which the shot is carried into contact with the trunk, or with the extremity wounded. Occasionally, however, in exceptional cases, there will be no external appearance of injury, notwithstanding the existence of serious internal disorganization. The rationale of such phenomena will be presently described.

Fragments of heavy shells generally produce immense laceration and separation of the parts against which they strike, but do not carry away, or grind structures, as round shot do. Ordinarily, the line of direction in which they move forms an angle more or less acute, with the part of the body wounded, and the injury done is rather superficial than deep. When they happen to strike in a more direct line, so as to penetrate and sink beneath the surface, the external wound is mostly smaller than the fragment itself, from the projectile not having had force enough to destroy the vitality and elasticity of the skin and other soft parts through which it has entered, so that these structures partially contract around the wound, and so lessen the size of its opening.

Small projectiles, with force enough to penetrate the body, leave one or more openings, the external appearances of which also vary according to the form and velocity of the projectiles by which they are caused. The appearance of a wound from a rifle-ball, at its highest rate of speed, may be sometimes witnessed in cases of suicide. A soldier, in thus destroying himself, mostly stoops over the muzzle of his firelock, pressing it against the upper part of his body, and springing the trigger by means of his foot or a piece of cord connected with it. The muzzle is usually applied beneath the chin. In such a case, a circular hole, without any puckering or inversion of the marginal skin, together with dark discoloration of the integument for several inches round, is observed at the wound of entrance. The vertex of the head is shattered; fragments of the parietal and occipital bones, together with small portions of brain, are carried away and scattered about; those bones which are not broken are loosened from their sutures; the great mass of the brain is torn to pieces, but held within by its membranes; the superficial vessels of the face are distended with blood. These effects are not wholly due to the passage of the ball; but partly to the flame and smoke from the ignited gunpowder jetting out at the mouth of of the musket, and in part also to the expansive force exerted within the cavity of the cranium, by the gases resulting from the explosion of the gunpowder.

When a musket-ball strikes a limb at some distance from the weapon by which it was propelled, but while still preserving great velocity, the appearances of the wound of entrance are different from those of the opening last described. An opening of about the size of the projectile is now observed, sometimes irregularly circular, with edges generally a little torn; sometimes consisting of three triangular flaps, which, on being lifted up, can be made to meet at their apices in the centre of the opening. In either case, the whole wound presents a slightly inverted aspect. There may be darkening of the marginal skin, of a livid purple tinge, from the effects of contusion or from dislodgement of powder which was adhering to the bullet, or it may be simply deadlike and pale. Should the ball have passed out, the wound of exit will be probably larger than the projectile, more irregular and torn than the wound of entrance, with slight eversion of its edges, and with protrusion of the subcutaneous fat which is thus rendered visible. These appearances are the more easily recognized the earlier the wound is examined. They are more obvious if a round musket-ball has caused the injury than when it has been inflicted by a cylindro-conoidal bullet. Indeed, with the latter, when it has passed, apex forwards, through the soft tissues of an extremity of the body at full speed, when it has neither struck a bone nor carried any foreign body before it, it is often very difficult to distinguish by its appearance the wound of entrance from that of exit. In medico-legal investigations concerning gunshot wounds, it sometimes is still a matter of great importance to decide this point; but to the military surgeon, more especially from the circumstances connected with the new projectiles, it has become a subject of much less practical interest than it formerly was. When the indirect and tortuous penetration of balls was the rule rather than the exception, a knowledge of the spot at which the ball entered was often useful in diagnosing the mischief it had probably committed in its passage, and in determining the part of the wound where foreign bodies might be supposed to be carried and to be lodging. When the track of the ball is nearly in a straight line, as now so frequently happens, such information cannot be looked for from knowing the relation of either opening to the course of the projectile.

The appearances of wounds resulting from penetrating missiles of irregular forms, as small pieces of shells, musket-balls flattened against stone, and others, differ from those caused by ordinary bullets in being accompanied with more laceration, according to their length and form. Being usually projected with considerably less force than direct missiles, such projectiles ordinarily lead only to one aperture, that of entrance.

Internal wounds without external marks.—Among the wide variety of injuries from gunshot, there have not unfrequently been noticed instances in which serious internal mischief has been inflicted, without any external marks of violence to indicate its having resulted from the stroke of a projectile. These peculiar cases have been before casually alluded to when describing the external appearances of wounds caused by cannon-balls striking a part of the body in a slanting direction. An important viscus of the abdomen has been ruptured, yet no bruising of the parietes observable; symptoms of cerebral concussion have shown themselves, yet no injury of the scalp to be detected. Even bones have been comminuted without any wound of the integuments or appearance of injury. The records of the Crimean campaign afforded not unfrequent examples of such wounds. In one case an English soldier had the whole shaft of a humerus shattered to pieces by a cannon-shot, yet the skin was as sound and as white as if it had not been touched. Two cases occur, in the French records, of fracture of the forearm without any external apparent lesion; in one, the internal structures were reduced to a mass of pulp. The difficulty of reconciling the several facts noticed in such instances, together with the vague descriptions by patients of their sensations, led surgeons to seek an explanation for them in the supposition that masses of metal projected with great velocity through the air might inflict such injuries indirectly by aërial percussion. Either the air might be forcibly driven against the part injured by the power and pressure of the ball in its flight, or a momentary vacuum might be created, and the forcible rush of air to refill this blank might be the origin of the hurt. Electricity has also been called into aid in explaining these injuries. All these hypotheses are now abandoned. So many observations have been made of cannon-balls passing close to various parts of the body, as near as conceivable without actual contact, without any such consequences as those attributed to windage, as to lead to the necessary conclusion that the theory must in all instances have been fallacious. Portions of uniform and accoutrements have been torn away by cannon-balls without injury to the soldier himself. Even hair from the head has been shaved off, and cases are on record where the external ear and end of the nose have been carried away without further mischief.

The true explanation of the appearances presented in those cases which were formerly called "wind-contusions," appears to rest in the peculiar direction, the degree of obliquity, with which the missile has happened to impinge against the elastic skin, together with the relative situation of the internal organs injured to this missile and to other hard substances in their neighborhood. The surface itself is not directly torn or cut into, because the impact of the projectile has not been sufficiently direct to effect an opening; but the parts beneath are crushed by the pressure to which they have been subjected between the combined influence of the weight and momentum of the ball on one side, and of some hard resisting substance on the other. Thus, on a cannon-ball passing across the abdomen, the elasticity and ready mobility of the skin may enable that structure to yield to the strain to which it is exposed, while viscera are ruptured by the projectile forcing them against the vertebral column. So the weight of a ball passing obliquely over a forearm may possibly crush the bone between itself and some hard substance against which the arm may be accidentally resting, without lesion of the interposed skin. Baron Larrey, who examined many fatal cases of this kind, relates that he always found so much internal disorganization as to leave no doubt in his mind of its being the result of contact with the ball. He explained the absence of superficial lesion, by the surface having been struck by cannon-balls in the latter part of their flight, when they had undergone a change of direction from straight to curvilinear, and acquired a revolving motion, owing to atmospheric resistance and the effect of gravitation. In such a condition, he argued, they would turn round a part of the body, as a wheel passes over a limb, in place of forcing their way through it; and while elastic structures would yield, bones and muscles, offering more opposition, would be bruised or broken.

Pain.—The amount of pain which follows a gunshot wound, more particularly one from a bullet, is a symptom which varies very much in degree according to the kind and situation of the wound, the condition of mind, and the state of constitution of the soldier at the time of its infliction. The instantaneous suddenness of the injury, and the previous occupation of the soldier's thoughts, usually prevent him from noting his own sensations with any approach to accuracy. It will sometimes happen that patients who have suffered simple flesh-wounds, will tell the surgeon they were not aware when they were struck; and the truth of such statements is attested by the fact that instances not unfrequently occur of soldiers continuing in action for some time without knowing they had been wounded. Sometimes the pain from the shot is described as a sudden smart stroke of a cane; in other instances as the shock of a heavy intense blow. Occasionally, when the trunks of nerves are directly injured short of division, as when they are violently pushed aside by a bullet, the pain will be referred to a distant part not involved in the track of the wound. Lieutenant M., of the 19th Regiment, was wounded by a musket-ball at the assault of the Redan, on September 8, 1855. His sensations led him to imagine that the upper part of his left arm was smashed, and he ran across the open space in front of the works supporting the arm which he supposed to be broken. On arriving at the advanced trench, he asked for water; on trying to drink, he found that his mouth contained blood, and that he was unable to swallow. The arm on examination was found to be uninjured, but a ball had passed from right to left through his neck, and from its direction had no doubt struck some portion of the lower cervical or brachial plexus of nerves. When a ball does not penetrate the flesh, but simply inflicts a contusion, the pain is often described by patients to be more severe than it is by others in whom a bullet has effected an entrance.

Shock.—When a large bone is suddenly shattered, a cavity penetrated, an important viscus wounded, a limb carried away by a round-shot, the most prominent symptom is the general perturbation and alarm which in most cases instantaneously supervene on the injury. This is generally described as the "shock" of a gunshot wound. The patient trembles and totters, is pale, complains of being faint, perhaps vomits. His features express extreme anxiety and distress. This emotion is in great measure instinctive; it is witnessed in the horse hit mortally in action, no less than in his rider; and seems to be sympathy of the whole frame with the part subjected to serious injury, expressed through the nervous system. This shock is more or less persistent according to circumstances. Examples seem to show that it may occasionally be overpowered altogether, even in most severe injuries, by moral and nervous action of another kind, by a state of mental tension; but this can rarely happen when the injury is a vital one. Panic may lead to similar symptoms of shock, although the wound is of a less serious nature. A soldier, having his thoughts carried away from himself—his whole frame stimulated to the utmost height of excitement by the continued scenes and circumstances of the fight—when he feels himself wounded, is suddenly recalled to a sense of personal danger; and if he be seized with doubt whether his wound is mortal, depression as low as his excitement was high may immediately follow. This depression will vary in degree according to individual character and intelligence, state of health, and other personal peculiarities. For while, on the one hand, numerous examples occur in every action of men walking to the field-hospital for assistance almost unsupported and with comparatively little signs of distress, after the loss of an arm or other such severe injury; on the other, men whose wounds are slight in proportion are quite overcome, and required to be carried.

As a general rule, however, the graver the injury, the greater and more persistent is the amount of "shock." A rifle-bullet which splits up a long bone into many longitudinal fragments inflicts a very much more serious injury than the ordinary fracture effected by the ball from a smooth-bore musket, and the constitutional shock bears like proportion. When a portion of one, or of both lower extremities is carried away by a cannon-ball, the higher towards the trunk the injury is inflicted, the greater the shock, independent of the loss of blood. Some writers in accounting for "shock" lay stress on the concussion, and general mechanical effects on the whole body, including the nerve-centres, from the momentum of the iron shot.[1] To a certain extent this may be true; but, judging from analogy in physics, the greater the velocity, and consequently the momentum, of a ball carrying away a limb, the less would the concussion of the trunk and the distal parts of the body be. A pistol-ball at full speed will take a circular portion out of a pane of glass without disturbing the remainder; if the speed be much slackened, as when fired from a distance, it will shake the pane to pieces.

That true "shock"—*ébranlement* of French writers—as distinguished from shock resulting from violent concussion, from mental depression after unusual excitement, or from the effects of groundless alarm on the part of a patient, is a phenomenon the essential relations of which are connected with vital force, and with that endowment of the organization only, may be judged from observation of cases in which the direct result of the wound is inevitably fatal, including many where no physical effects on neighboring parts from concussion could possibly be produced. In such injuries the "shock" remains, from the time of first production of the fatal impression till life is extinguished. And the practical experience of every army surgeon teaches him that where a ball has entered the body, though its course be not otherwise indicated, the continuance of shock is a sufficient evidence that some organ essential to life has been implicated in the injury. That the shock of a severe gunshot wound may be complicated with other symptoms, or that some of its own symptoms may be exaggerated from other causes—hopes disappointed, the approach of death, and all the attendant mental emotions—scarcely affects the question at issue; for its existence, independent of these complications, in all such cases is undoubted.

Primary hemorrhage.—This is one of the accompaniments of gunshot wounds, which, as might be expected, varies very greatly in degree according to the size and situation of the bloodvessels wounded. In some gunshot wounds there is hardly any perceptible hemorrhage, a mere oozing: in others, the hemorrhage is to such an extent, as, of itself, to cause speedy death. Much difference of opinion has been expressed concerning the number of deaths which result after gunshot injuries from primary hemorrhage on a field of action; and the question of the proportion of fatal consequences from this cause, to deaths from other causes, in warfare, is still an open one. There is no doubt about the fact that primary hemorrhage of a serious nature from gunshot wounds does not often come within the surgeon's observation. If hemorrhage occur from one of the main arteries, and is unattended to, it probably proves rapidly fatal; and most surgeons after an action are too much occupied with the urgent necessities of the living wounded to spare time for examining the wounds of the dead, who are usually buried as soon as practicable on the field where they have fallen. Thus many surgeons speak of primary hemorrhage being exceedingly rare, because they have not met with it in their own experience; a statement which more extended observation might, perhaps, have considerably modified. M. Baudens, on the other hand, referring to his service in Algeria, has remarked that he has often found, by examination of the dead lying on the field of battle, that death had resulted from primary hemorrhage.

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[1] In the Medical and Surgical History of the War against Russia in the Years 1854–55–56, published by authority, vol. ii., p. 265, the physical effects of concussion in producing "shock" are strongly dwelt upon. It is remarked: "The shock of the accidents frequently witnessed by the military surgeon differs, often in a very material degree, and possibly in kind also, from that witnessed in civil life. When a cannon-shot strikes a limb and carries it away, the immense velocity and momentum of the impinging force can scarcely be supposed to have no physical effect upon the neighboring or even distant parts independent of, and in addition to, the 'shock' in the ordinary acceptation of the term, which would result from the removal of the same part by the knife of the surgeon, or the crushing of it by a heavy stone or the wheel of a railway wagon. . . . In the great majority of cases, the whole frame is likewise violently shaken and contused, and probably, independent of the physical effects, a further vital influence is exerted, which exists in a very minor degree, if at all, in the last-named injuries, and may possibly depend upon the ganglionic nervous system."

Ordinarily, so far as the wounds from great projectiles to which the surgeon's attention is called are concerned, and in which some of the larger arteries have been divided, the primary hemorrhage is generally found to have been comparatively small in quantity and of short duration —a sudden flow at the moment of injury, and nothing more. When a part of the body is carried away by round shot or shell, the divided arteries are usually observed to be nearly in the same state as they are found to be when a limb is torn off by machinery. The lacerated ends of the middle and inner coats are retracted within the outer cellular coat; the calibre of the vessel is diminished, and tapers to a point near the line of division; it has become plugged within by coagulum; and the cellulo-fibrous investing sheath, and the clot which combines with it, form on the outside an additional support and restraint against hemorrhage. When large arteries are torn across, and their hemorrhage is thus spontaneously prevented, they are seldom withdrawn so far but that their ends may be seen protruding and pulsating among the mass of injured structures; yet, though the impulse may appear very powerful, further loss of blood is rarely met with from such wounds.

The smaller forms of projectiles, again, do not appear to lead to primary hemorrhage so frequently as might be expected, if we except small fragments of shells, splinters of wood, and other indirect missiles with sharp edges. These angular fragments will cause vessels to be divided, which would have escaped from being opened had they been brought into collision with missiles having smooth surfaces and convex outlines. It comparatively rarely happens, indeed, that the surgeon sees any of the larger arteries cut across by musket bullets, either round or conical. The lax cellular connections of these vessels, the smallness of their diameters in comparison with their length, the elasticity as well as toughness of the tissues forming their coats, the fluidity of their contents, and, in consequence of all these conditions, the extreme readiness with which they slip aside under pressure, constantly act as means of preservation, even although these important structures are subjected to such imminent danger as the passage of a musket-ball in their direction. Endless examples occur where a ball appears to have passed through a part of the body in the exact situation of an important artery, so that it must have been pushed aside by it, or it could not have escaped division. Mr. Guthrie has recorded a case where a ball even opened the sheath of the femoral vessels, and passed between the artery and vein, in a soldier at Toulouse, without destroying the substance of either vessel. So close was the ball, and such contusion was produced, together with, doubtless, injury to the vasa vasorum, that the artery became plugged with coagulum and obliterated. A preparation of the vessels referred to in this case is in the Museum at Netley. Another case is mentioned by Mr. Guthrie, where the direction of a ball between the left clavicle and first rib, and permanent diminution of the pulse in the arm on the same side, led to the conclusion that the subclavian had escaped direct destruction by the missile in a similar way. I have several times met with examples of obliteration of vessels, produced in a similar way, among men invalided from the effects of wounds, at Chatham and Netley.

The position of a limb or artery when struck may prevent such a happy escape. On examination of the wound of Captain V., of the 97th Regiment, whose death led to so much interest in England, I found that he had been struck by a ball which had penetrated the right axilla and divided the axillary artery. His arm had apparently been stretched out when he received the injury, probably in the act of holding up his sword. The night was very dark, the distance from the place where the sortie took place in which he was wounded to the camp-hospital was more than a mile and a half, and he sank from hemorrhage while being carried up. Mr. Guthrie mentions the cases of two officers who were killed, almost instantaneously, one by direct division of the common iliac artery, the other of the carotid. The death of an officer from division of the femoral artery is recorded in the Surgical History of the Crimean War. Other cases are mentioned, though not immediately fatal, of a wound of the femoral vein and profunda artery in the same subject from a conical bullet; and one of the popliteal artery and vein, also from a rifle-ball.

PROGNOSIS.

In estimating the probable issue of a particular wound, but only its nature and the patient's state of health at the time must be taken into account, but, if he be a soldier, his previous service and the diseases under which he has labored during it, and the circumstances in which he is placed with respect to opportunity of proper care and treatment, must also be carefully weighed. The time which has elapsed after the receipt of the injury is another important matter in forming a prognosis. The difficulties which have been already enumerated in the way of arriving at a safe diagnosis of the true nature and extent of the injury, and the liabilities already mentioned to which a patient with a gunshot wound is exposed, should put a surgeon on his guard against giving a hasty judgment in any case that is not very plain and simple. Military surgery abounds with examples of wounds of such extent and gravity as apparently to warrant the most unfavorable prognosis, which have nevertheless terminated in cure; while others, regarded as proportionably trifling, have led to fatal results. The mortality among gunshot wounds is not merely dependent upon the direct effects of the injuries which have been inflicted, but is in a large proportion due to subsequent complications: secondary hemorrhage, gangrene, erysipelas, hectic fever, pyæmia, and the results of operations required as consequences of the original wound. The amount of mortality from these secondary causes in military practice is again greatly influenced, in the first place, by the distances to which soldiers have had to be removed before reaching their places of treatment, and the modes of their removal; and, in the second place, by the opportunities which exist for hygienic arrangements, and especially for dissemination of the wounded when many wounds are caused at the same time, or upon the degree in which the importance of these influences is appreciated. Tables may be found in works showing statistically the nature and relative numbers of wounds and injuries received in various actions, with their immediate and remote consequences, as well as the results of the surgical operations they have led to; but these afford little aid towards the prognosis of particular cases, each of which must be estimated according to its own individual features and circumstances. Such tables are chiefly of value in affording indications of the average effects of different modes of treatment in wounds of a corresponding nature among patients under like circumstances and conditions. Even moral circumstances must not be disregarded in forming a prognosis. The probable issue in any given case will be very different in one soldier, who is supported by the stimulating reflection that he has received his wound in a combat which has been attended with victory, from what it will be in another, who labors under the depression consequent upon the circumstances of defeat.

TREATMENT OF GUNSHOT WOUNDS IN GENERAL.

When the circumstances of a battle admit of the arrangement, the wounded should receive surgical attention preliminary to their being transported to the regimental or general field hospitals in rear. A slight provisional dressing, a few judicious directions to the bearers, may occasionally prevent the occurrence of fatal hemorrhage, or avert serious aggravation of the original injury from malposition, shaking, and spasmodic muscular action, in the course of conveyance from the neighborhood of the scene of conflict to the hospital. In the open field this attention is given by surgeons placed at what are called the "first lines of surgical assistance," positions near enough to the scene of fighting for the surgeons to be able to afford speedy help to the wounded, and at the same time such as to ensure, as far as possible, protection both to the surgeons and their patients against risk of injury from shot. In siege operations, among British troops similar assistance is afforded by surgeons stationed at fixed places, generally shot-proof, constructed in the trenches; among French troops by flying field-hospitals, "ambulances volantes," placed in suitable sheltered spots in the ravines or roads leading down to them.

The provisional treatment should be of the simplest kind, and chiefly directed to the prevention of additional injury during the passage to the "second line of surgical assistance" or field-hospital, where complete and accurate examination of the nature of the wound can alone be made, and where the patient can remain at rest after being subjected to the required treatment. The removal of any missiles or foreign bodies which may be readily obvious to sight or touch; the application of a piece of lint to the wound; the arrangement of any available support for a broken limb; protection against dust, cold, or other objectionable circumstances likely to occur in the transit; if "shock" exist, the administration of a little wine, aromatic ammonia, or other restorative, in water; these and other such acts of primary attention, require little time for their execution, and may prove sources of great comfort and much service to a wounded patient. If hemorrhage exist from injury to a large vessel, it must of course receive the surgeon's first and most earnest care. He should not trust to the pressure of a tourniquet, but secure it at once by ligature. Without this safeguard during the transport, and while in the hands of uneducated attendants, the life of the wounded man might be endangered, either from debility consequent upon gradual loss of blood, or from sudden fatal hemorrhage. It has been recommended by some surgeons that all attendants whose duties consist in carrying the wounded from a field of battle should be directed, when bleeding is observed, to place a finger in the wound and keep it there during the transport, until the aid of a surgeon is obtained. The precise spot where compression by the finger is wanted, and the degree of pressure necessary, will be quickly made manifest to the sight by the effects on the flow of blood. This practice has been extensively followed in some armies, and it seems to be open to less objection than the use of tourniquets by men whose knowledge of their proper application must often be exceedingly limited.

On arrival at the field-hospital, where comparative leisure and absence of exposure afford means of careful diagnosis and definitive treatment, the following are the points to be attended to by the surgeon: first, examination and exploration of the wound, with a view to obtaining a correct knowledge of its nature and extent; secondly, removal of any foreign bodies which may have lodged; thirdly, adjustment of lacerated structures; and, fourthly, the application of the necessary dressings.

The diagnosis should be established as early as possible after the arrival of the patient at the field-hospital. An examination of the wound can then be made with more ease to the patient and more satisfactorily to the surgeon, than at a later period. Not only is the sensibility of the parts adjoining the track of the ball numbed, but there is less swelling to interfere with the examination, so that the amount of disturbance effected among the several structures, and the lodgment of any foreign bodies among them, are more obviously apparent. The importance of making a complete examination of the wound at this early period cannot be overrated.

One of the earliest rules for examining a gunshot wound, is to place the patient, as nearly as can be ascertained, in a position similar to that in which he was in relation to the missile at the time of being struck by it. In almost every instance the examination will be facilitated by attention to this precept. Occasionally it will at once indicate the probability of injury to the surface of a bone, to joints, or other important structures, in cases where the mutual relations of the wounds of entrance and exit, in either the erect or horizontal posture of the body, would lead to no such information. Injury to nerves, inducing paralysis; contusions of bloodvessels, liable to lead to secondary hemorrhage or gangrene, may, without sufficient circumspection in this respect, be overlooked on the patient's first admission to hospital.

When only one opening has been made by a ball, it is to be presumed that it is lodged somewhere in the wound, and search must be made for it accordingly. But even where two openings exist, and evidence is afforded that these are the apertures of entrance and exit of the projectile itself, examination should still be made to detect the presence of other foreign bodies. Portions of clothing, and, as has already been mentioned, other harder substances, are not unfrequently carried into a wound by a bullet; and, though it itself may pass out, these may remain behind, either from being diverted from the straight line of the wound, or from becoming caught and impacted in the fibrous tissues through which the ball has passed. The inspection of the garments worn over the part wounded may often serve as a guide in determining whether foreign bodies have entered or not, and if so, their kind, and thus save time and trouble in the examination of the wound itself.

Of all instruments for making a complete examination of a gunshot wound, as well as for exploring for foreign bodies which may be lodged in it, the finger of the surgeon is the most appropriate. By its means the direction of the wound can be ascertained with least disturbance of the several structures through which it takes its course. If bones are fractured, the number, shape, length, position, and degree of looseness of the fragments may be more readily observed. Exploration by a finger will establish the fact of a joint being opened in cases where the injury to the articulation would have remained a matter of doubt if a probe had been used instead. When foreign bodies are lodged, not only is their presence more obvious to the finger direct than through the agency of a probe, or other metallic instrument, but by its means intelligence of their qualities is also communicated. A piece of cloth lying in a wound is recognized at once by a finger; while, saturated with clot, as it is under such circumstances, it will probably be mistaken for some of the natural soft parts by any other mode of examination. The index-finger naturally occurs as the most convenient for this employment; but the opening through the skin and fascia made by a rifle-ball of small diameter, is sometimes too contracted to admit of its free entrance, and in this case the substitution of the little finger will probably answer all the purposes intended. When the finger cannot reach sufficiently far, owing to the depth of the wound, the examination for foreign bodies is often facilitated by pressing the soft parts from an opposite direction towards the finger-end.

If the finger fail, even when the soft parts have been approximated, as described, and if the lodgment of a projectile be still suspected, we are compelled to make further exploration by other means. Under ordinary circumstances a long silver probe, that admits of being bent by the hand if required, is perhaps the best substitute for the finger. Elastic bougies or catheters are apt to become curled among the soft parts, and do not convey to the sense of touch the same amount of information as metallic instruments do. The probe should be employed with great nicety and care, for it may inflict injury on vessels or other structures which have escaped from direct contact with the ball, but have returned, by their elasticity, to the situations from which they had been pushed or drawn aside during its passage. Nélaton's test-probe, in which a small knob of biscuit china is prepared for taking an impression of lead or rust, on being rubbed against a leaden or iron projectile; Lecompte's stylet-pince, in which an arrangement exexists for nipping off and bringing away a minute fragment of a supposed foreign body for observation; electric indicators, such as Rhumkorff's apparatus, or the more modern appliance of Mr. De Wilde, in which contact with metal at the bottom of a wound is notified by the sound of a bell; these and other such exploring instruments are chiefly useful in solving questions of lodgment in chronic cases of gunshot wounds. Such appliances can rarely be required in the cases which come before military surgeons in field-hospitals.

The directions just given for examining wounds to detect lodgment of foreign bodies apply more particularly to such as penetrate the extremities, or extend superficially in other parts of the body; where a missile has entered any of the important cavities, search for it is not to be made, but the surgeon's attention is to be directed to matters of more vital importance to be hereafter noticed.

As soon as the site of lodgment of a ball or other foreign body is ascertained, as a general rule, it should be removed. If it be lying within reach from the wound of entrance, it should be extracted through this opening by means of some of the various instruments devised for the purpose. In case of a leaden bullet, Coxeter's extractor, corresponding with Baron Percy's instrument for the same purpose, and consisting of a scoop for holding, and central pin for fixing, the bullet, has been found a very convenient appliance, from the comparatively limited space required for its action. Instruments of two blades, or scoops, with ordinary hinge action, dilate the track of the wound injuriously before a foreign body can be grasped by them; but when the blades are capable of being inserted separately, and then of being united, after the manner of midwifery forceps, this objection is obviated, and they are then very serviceable for removing small iron balls, fragments of shells, and similar hard projectiles.

The way to the removal of a bullet may often be smoothed by judiciously clearing away the fibres among which it is lodged, during the digital examination; and sometimes, by means of the finger in the wound, and external pressure of the surrounding parts, the projectile may be brought near to the aperture of entrance, so that its extraction is still further facilitated. Such foreign substances as pieces of cloth can usually be brought out by the finger alone, or by pressing them between the finger and a silver probe inserted for the purpose. Sometimes a long pair of dressing forceps, guided by the finger, is found serviceable for effecting this object. Caution must of course be used, in employing forceps in this way where the foreign substance is out of sight, and of such a quality that the soft tissues may be mistaken for it. It does not often happen that it is necessary to enlarge the openings of wounds to remove balls, although a certain amount of constriction of the skin may be expected from the addition of the instrument employed in the extraction; but if much resistance is offered to their passage out, it is better to divide the edges of the fascia and skin to the amount of enlargement required, than to use force. In removing fragments of shells, the fascia and skin have almost invariably to be divided, sometimes to a considerable extent.

In removing slugs, stones, and other irregularly-shaped bodies, the surgeon cannot be too guarded in arranging that the fragment is drawn away with its long axis in line with the track of the wound. By proper care in this respect, much injury to adjoining structures may be avoided. This rule specially applies to modern elongated bullets, some of which have a long diameter of an inch and a quarter or upwards, with a short diameter of only four-tenths of an inch; with a round bullet no attention is necessary as to its extraction in any particular direction.

When the foreign body has not completely perforated, but is felt to be lying near the surface of a part at some distance away from the wound of entrance, an incision must be made for its extraction. Before using the knife, the substance to be removed should be fixed *in situ*, by pressure on the surrounding parts. In the instance of a round ball, the incision through the skin and fascia should be carried beyond the length of its diameter; an addition of half a diameter is usually sufficient to admit of the easy extraction of the ball.

When cylindro-conoidal bullets lodge in one of the extremities in the manner described, it will very generally be found that the base of the bullet presents itself toward the surface, owing to its having made a partial revolution upon one of its short axes, while traversing the limb, and an incision of proportionate length should be made for its removal.

If balls are impacted in bone, as occasionally happens in the spongy heads of some bones, in the bones of the pelvis, and, though rarely, in portions of the shafts of long bones, they should equally be removed. The fact is now fully established that, although in a few isolated cases balls remain lodged in bones without sensible inconvenience, in the majority the lodgment leads to such disease of the bony structure as to entail troublesome abscesses, and if it be in a bone of one of the extremities, eventually to necessitate amputation. If the bullet be superficially lodged, its removal can be effected by means of a steel elevator, of convenient size; or, should this fail from the ball being too firmly impacted, a thin layer of the bone on one side of the ball may be gouged away, when a better purchase will be obtained for the elevator, and its action be thereby facilitated. If the impaction be deep, and it be a leaden bullet, the "tire-fond" screw, which is much used by French military surgeons, or Luer's sharp-pointed bullet-forceps which bite into and secure a most firm grasp of the object, will best accomplish the extraction. The lodgment of balls, even in the cancellous apophyses of bones, will not often occur without extensive fracture where rifle-balls strike with force, but will still happen when their momentum is much diminished.

Whatever reason there may be, however, for concluding that a ball or other foreign body has lodged in a wound, if, after a moderate amount of manual examination, and observations made in varied postures of the part of the body supposed to be implicated, after attention has been given to indications derived from the patient's sensations, effects of pressure upon or injury to nerves, and to all other circumstances which may lead to information—if after all these steps have been taken the site of the lodgment be not ascertained, the search should not be unreasonably persevered in to the distress of the patient. And even if the site of lodgment be ascertained, if the removal of the foreign body can only be effected by violence, or by severe and extensive incisions, or if there is danger of wounding important organs in trying to reach it, the attempts at extraction should not in ordinary cases be continued. In short, although immediate extraction of a bullet is the rule, it is not to be followed beyond reasonable limits or at all hazards. Either during the process of suppuration, by some accidental muscular contraction or by gradual approach toward the surface, its escape may be eventually effected without such risks; or, if of a favorable form, and if not in contact with nerve, bone, or other important organ, it may become encysted, and remain without causing either pain or mischief. John Hunter has recorded, in his treatise on gunshot wounds, that the practice of searching after a ball, broken bones, or any other extraneous bodies, was then in a great measure given up from experience of the little harm caused by them when at rest and not in a vital part; and he himself advises, even when a ball can be felt beneath skin that is sound, that it should be let alone, chiefly on the ground that two wounds are more objectionable than one, and that the extent of inflamed surface is proportionably increased by incision. More extensive experience has shown, that not only is the risk of subsequent ill results greater in those cases where foreign bodies remain lodged than when they have been cut out, but also that the advantages of a second opening, for the escape of the necessary sloughs and discharges, greatly preponderate over the disadvantages connected with it as regards the additional extent of injured surface. The advantage also of the satisfaction to the mind of a patient from whom a ball has been removed must not be overlooked; for men suffering from gunshot wounds are invariably rendered uneasy by a vague apprehension of danger, for some time after the injury, if the missile has remained undiscovered.

In the majority of gunshot wounds, early care and attention will suffice to effect the removal of any foreign bodies lodged in them, and, as soon as this has been accomplished, whenever a wound has been accompanied with much laceration and disturbance of the parts involved in the injury, the next point to attend to is to readjust and settle the disjoined structures as nearly as possible in their normal relations to each other. The simplest means—strips of adhesive plaster, light pledgets of moist lint, a linen roller, sure against the skull by means of a bandage will generally suffice to stop it; not always, however, for it has happened to the writer not to be able to arrest the bleeding of a divided artery hanging patulous from among the torn and contused tissues, neither by pressure, nor by torsion, nor exposure to cold, and a ligature has had to be placed on both divided ends.

When the patient has reached the field hospital, the horizontal position being still maintained, an attendant should shave the hair from the head around the seat of injury, so that a careful examination may be made by the surgeon. As in all other gunshot wounds, the examination should be made as early as possible, and as soon as the surgeon has satisfied himself as to the nature of the wound, the patient should be kept quiet, that he may gradually recover from the state of concussion and collapse, in which he will still probably be found at the time of his arrival at the hospital.

[When the depression of the powers of life is great, and there is danger of death from shock, as frequently is the case after such injuries, the head should be slightly elevated, warmth applied to the body, and some diffusible stimulant cautiously administered; by the mouth if the patient can swallow, if not, by the rectum, or hypodermically. Ammonia or brandy or wine may be given, the first being less permanent in its effects and probably preferable on this account. The surgeon should keep in view the fact, however, that the reaction is generally in proportion to the depression, and inflammation and its effects are sure to follow; and as soon as the danger from collapse passes off, the head should be farther elevated, and the warmth and stimulants withdrawn. Laceration of the brain may also be present, and injudicious stimulation encourages internal hemorrhage.]

It will be convenient to consider the treatment to be adopted in each of the varieties into which these wounds have been classified.

Wounds without fracture of bone.—Supposing that the effects of contusion of the scalp are alone exhibited, the application of cold water-dressing, cold affusion, or ice bladders, if they can be obtained, to the head, is the only local treatment required. Whatever may be the extent of ecchymosis, and whatever its form, whether it be beneath the tendon of the occipito-frontalis muscle or diffused beneath the skin, the swelling should on no account be incised; an opening will take away all chance of the effused blood being absorbed. If the effusion be extensive, suppuration is not unlikely to occur under any circumstances, and then opening is unavoidable, but every effort should be made to prevent it at the onset. It is occasionally recommended by Continental surgeons to make strong pressure upon the protuberances caused under such circumstances, with a view to cause the dispersion of the blood in the cells of the neighboring areolar tissue. A piece of thin metal, placed in a compress, the pressure being maintained by a tight bandage, is the plan sometimes adopted for the purpose. But considering the situation of the injury, this mode of treatment appears to be neither so scientific nor likely to be so generally useful, as moderate pressure with appropriate cooling remedies. The thick and voluminous bandaging occasionally placed around a patient's head, with the intention perhaps of keeping the wet lint which has been applied to the injured part in its place, is also very objectionable, because it tends rather to promote than to prevent suppuration. Such restraining bandages should always be of the simplest and lightest character. Nothing can be better for the purpose than the six-tailed head bandage, especially when it is made of fenestrated linen to ensure additional coolness.

The general treatment should be all directed to limiting the amount of reaction, and preventing inflammatory action among the important structures in the immediate neighborhood of the seat of injury. This applies to the general treatment of every wound of the head, however trivial and however severe; and most especially in cases where the injury has been caused by the stroke of a direct projectile. An active purgative should be administered. The utmost abstemiousness as regards diet and drinks should be enjoined. In no injuries is the importance of abstinence rendered so manifest by the ill consequences of its neglect, as in injuries of the head. Excitement and disturbance of all kinds should be avoided. If the injury be apparently a slight one, the surgeon may find it very difficult to enforce the regimen here indicated; but, for some days at least, however urgent may be the appeals of the patient, he should by no means give his consent to the rules laid down being infringed. Apparently slight as the injury may be, a slight excess may quickly convert it into a serious one.

The same treatment, local and general, is applicable to cases in which the only difference is the existence of an open wound. When caused by small projectiles, these scalp wounds are usually furrowed wounds, scooped out, as it were, their whole length; but sometimes the bullet, after entering the scalp, travels along some distance between it and the cranium, and makes a tunnel-like passage agent as a local dressing that can be employed, in military hospitals containing many patients with suppurating and sloughing gunshot wounds.

Under all circumstances, the strictest attention to cleanliness, the regular and complete removal of all foul dressings, and free aëration of the wards, are essentially necessary, both for the comfort and general well-being of patients with gunshot wounds, as well as to allow the granulating process of repair in the wounds to go on healthily and without interruption. It cannot be expected that without these hygienic requisites, the serious evils which result from the accumulation and dissemination of noxious effluvia, in places where many patients with sloughing and suppurating wounds are gathered together, can be averted by any amount of disinfecting or antiseptic agents. In tropical climates, and in field-hospitals in mild weather, where many wounded are congregated, flies propagate with wonderful rapidity, and the utmost care is necessary to prevent the deposit of ova and generation of larvæ in the openings of gunshot wounds, especially while sloughs are in process of separation. Cloths dipped in weak solutions of creasote, lotions containing oil of turpentine and camphor, and other similar applications, have been employed to avert this repulsive complication of gunshot wounds, when these insects have abounded in great numbers.

It was once the custom to enlarge the orifices of gunshot wounds by incision; and sometimes not merely the openings, but also the walls of the tracks tunnelled by bullets. The opinions held by the older surgeons respecting the nature of these injuries, already briefly adverted to in the historical remarks on the subject, sufficiently explain their object in making these incisions, namely, to convert what they regarded as poisoned into simple wounds. Even so late as 1792, Baron Percy, in his Manuel du Chirurgien d'Armée, writes, "The first indication of cure is to change the nature of the wound as nearly as possible into an incised one." The treatment by incision continued even after the idea that gunshot wounds were poisoned wounds had been exploded, the advocates for the practice arguing that it was necessary to obviate tension, and prevent strangulation of neighboring tissues by tumefaction, on inflammation arising in the track of a projectile. This practice retained such a hold in France, that French surgeons usually still consider it necessary to discuss the merits or otherwise of "débridement" of gunshot wounds; opinion among Continental surgeons, however, now appears to be almost universally opposed to the practice. English surgeons generally discarded it after the arguments urged by John Hunter against it, just about the same date as Baron Percy wrote, excepting only in cases where it is required to allow of the extraction of some extraneous body; to secure a wounded artery; to replace parts in their natural situation, as in protrusion of viscera, in wounds of the abdomen; or, "in short, when anything can be done to the part wounded, after the opening is made, for the present relief of the patient, or the future good arising from it."

During the late war of the rebellion in the United States, Professor Chisholm, of South Carolina, introduced a plan of incising the orifices of gunshot wounds with a different object from that of the practice of "débridement." He pared the edges of the wound in such a way as to prepare them for union by adhesion, and thus sought to convert the open into a subcutaneous wound. His plan, which was designated "the new method of rapidly healing gunshot wounds," was tried to a limited extent in the British army in New Zealand during the recent Maori war, but was not attended with success.[1]

The constitutional treatment of a patient with an ordinary gunshot wound, uncomplicated with injury to bone or structures of first importance, should be very simple. The avoidance of all irregularity in habits tending to excite febrile symptoms or to aggravate local inflammation, attention to the due performance of the excretory functions, and support of the general strength, are chiefly to be considered. Bleeding, with a view to prevent the access of inflammation in such cases, is now never practised, as formerly, by English surgeons. The diet should be nutritious, but not stimulating. A pure fresh atmosphere is a very important ingredient among the means of recovery. If from previous habits of the patient, or from circumstances to which he is unavoidably exposed, the local inflammation becomes aggravated, topical depletion by leeches, saline and antimonial medicines, with strict rest of the injured part, should be had recourse to, the extent being regulated by the circumstances of each case. In instances such as these, when the inflammation has become diffused, the purulent secretion seldom confines itself to the track of the wound, but is apt to extend among the areolar connections of the neighboring muscles; and if the cure be protracted, attention will be necessary to prevent the formation of sinuses. If a tendency to stiffness or contraction is ex-sion of a magazine; the cause of the seventh injury is not stated. When to the risks already mentioned above, the fact is added that but seven survivals occurred after forcible elevation of depressed fractured bone, four of them only by trephining, in the British army during the whole Crimean campaign; that these took place after injuries from projectiles of comparatively low force and velocity; and that in the majority of the cases the dura mater had not been penetrated; the limited value of trephining in gunshot wounds of the cranium seems to be strongly borne out by the experience of that war. In the French report, by Dr. Scrive, it is stated that trephining was, for the most part, fatal in its results in the French army. In siege-operations, the experience as regards wounds of the head is always very extensive, the lower parts of the body being so much more protected in the trenches. According to Dr. Scrive's returns, one of every three men killed in the trenches before Sebastopol, and one in every 3.4 wounded, was injured in this region. In the English returns, wounds of the head and face in the men are shown as 19.3 per cent; in the officers, as 15 per cent.; but this is of the total wounded in the field as well as in the trenches.

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[1] A report on this subject will be found at page 523 of vol. vii. of the Army Medical Reports, London, 1867.

The experienced German surgeon, Dr. Stromeyer, who in the early part of his professional career advocated trephining in complicated fractures of the skull, states in his Principles of Military Surgery, that he has been led to abandon the practice. He has recorded that after the battle of Kolding, in Schleswig, in 1849, there were eight gunshot fractures of the skull, with depression, and more or less cerebral symptoms. In all these, with one exception, the detachment of the fractures was left to nature, and all recovered. The exception was that of one patient, from whom some fragments were removed on the seventh day, and he was placed in such considerable danger by the treatment, that Dr. Stromeyer resolved never to adopt it again. In the following year in Schleswig, two young surgeons came under Dr. Stromeyer's care with gunshot wounds of the head, accompanied by deep depression; they were both treated without trephining, and both recovered. Throughout the three campaigns of the Schleswig-Holstein war, Dr. Stromeyer records that there was only one case of trephining which gave a favorable result. Of eight cases of fracture of the cranium, with displacement of both tables, recorded by Dr. Williamson, among men who were wounded during the Sepoy mutiny in India and who subsequently arrived at Chatham, none had been trephined. In all these there was a depressed cicatrix, the wound having contracted and become closed by a strong fibrous investment. In one case—a wound by a musket-ball in the centre of the forehead—the ball was supposed to be still lodged within the skull. No soldier reached Chatham from India on whom the operation of trephining had been performed. We are not yet aware of the total experience in regard to the practice of trephining during the Italian campaign of 1859, or in the German war of 1866. It appears that in the former war the results of the observations in the Crimea by the French and Sardinian surgeons, and the latest German experience, led to the operation being very rarely resorted to in any one of the three armies engaged. But the experience gained during the late war in the United States, so far as it has been published, has a tendency to unsettle our notions on the subject again. The Surgeon-General's circular issued in 1865, containing Reports on the Extent and Nature of the materials available for the preparation of a Medical and Surgical History of the Rebellion, states that out of 107 terminated cases in which the operation of trephining was employed, sixty died and forty-seven recovered; a ratio of nearly forty-four per cent. of recoveries. In 114 cases fragments of bone or of foreign substances were removed by the elevator or forceps, and of these sixty-one died and fifty-three recovered—a ratio of more than forty-six per cent. of recoveries. But the report further states that "the data are not sufficiently complete to admit of fair comparative analysis; still it is difficult to avoid the impression that a larger measure of success has attended this operation in the late war than the previous experience of military surgeons would have led us to anticipate." It is evident before conclusions can be drawn from the American statistics that the nature of the cases in which the trephine was employed should be known,—in how many the dura mater was opened, and in how many not,—and other such circumstances affecting the results of gunshot wounds of the head. In European military practice the experience of recent years would cause the trephine to be employed only in cases which were otherwise hopeless; perhaps the American surgeons may have applied it with less hesitation in ordinary cases of depressed fracture. At any rate, as the report itself indicates, deductions regarding the effect of this treatment in the United States must be withheld until all the experience has been gathered together, and the medical and surgical history, which is still in progress, of the whole war, is complete.

[The following table is taken from the Surgical History of the War of the Rebellion, vol. i., p. 309:—

the base of the cranium. [This statement is partly confirmed by the results reported in the Surgical History of the War of the Rebellion, vol. i., page 126, where in 221 cases the seat of injury is specified. In contusions of the frontal and temporal bones nearly fifteen per cent. died; in contusions of the parietal thirteen; and of the occipital nine per cent. were fatal.] When the injuries are caused by rifle-balls coming into collision with the head at a high rate of speed, however, these considerations respecting position are rarely of much avail, for the usual force of these projectiles is such that the injury is scarcely ever confined to the immediate neighborhood of the part directly struck. When caused by bullets whose velocity has been in a great degree spent, or by small fragments of shell, the injuries may be localized, and the accident of situation then becomes a point to be considered in estimating the probable issue of any particular case.

Perhaps the most striking early feature which first attracts the notice of the observer of gunshot wounds of the head as they occur in field practice, if he has only been accustomed to seeing wounds of the head from violent blows as they are met with in civil life, is, in the majority of cases, the small amount of *evident* injury compared with the amount of *real* injury. A large proportion of the wounds of the upper and side parts of the head which are brought to civil hospitals, present extensive bruisings and lacerations, the scalp hanging down in flaps, the bone bared, and complications such as mutilation of the face and features, with much hemorrhage, but after all with comparatively little mischief of a permanent nature to the encephalon. The majority of head wounds on a field of action, being caused by small projectiles, exhibit no such extensive disfigurements, and are accompanied with comparatively little bleeding; while not improbably the condition of a patient from the effects of such an injury is as grave as if his head had been beaten by repeated blows with a hammer or crushed by a carriage wheel. The experience of the civil surgeon leads him to entertain the idea of a speedily fatal issue only when the usual evidences of deep and extensive injury are obvious to sight; the experience of the military surgeon leads him always to hesitate in forming a prognosis, however limited a gunshot injury may appear to be at first observation.

As regards more remote results, in a considerable proportion of the cases of direct wounds of the head which are presented in civil practice, the violence which has caused the injury is subject to the restorative powers of the structures injured; the inflammation which follows is of the plastic and reparative kind. On the other hand, in by far the greater number of cases which occur in military practice, the violence which has caused the injury, even though not of an immediately fatal nature, is in excess of the restorative powers of the structures directly injured; while the concussion and contusion which at the same time are inflicted on neighboring tissues are also so severe as to cause the inflammation which follows to be of an unhealing character—to be productive of sloughing, diffused meningitis, and encephalitis, the formation of deeply-seated abscesses, or of long-continued purulent and sanious discharges.

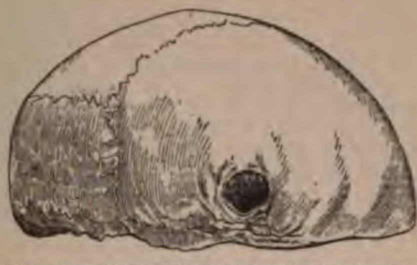
Of indirect injuries, fractures of the base or other parts of the cranium by counterstroke, such as are caused by falls from considerable heights, and which are of so serious a nature in civil hospital practice, comparatively few examples are met with in military field practice. This is only what might be expected from considering the nature of the projectiles and forces by which wounds of the head are produced in battle.

The appearances presented externally by the openings of entrance and exit in the cranium after a perforating wound of the head, in the one case by a round ball, and in the other by a conoidal rifle-ball, are shown in the following drawings. (See next page.)

Fig. 752 is copied from the calvarium of an officer who was killed by a large duelling pistol-ball. The regular defined opening of entrance, corresponding with the projectile itself in form and size, is well marked, as is also the larger and bevelled aspect of the wound of exit in fig. 753. The absence of fissures is worthy of note.

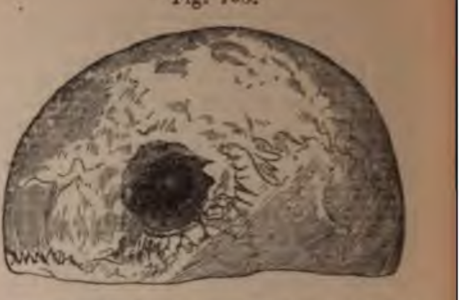
The next figure (fig. 754,) is copied from the calvarium of a soldier who was wounded in the head by a rifle-ball in the trenches before Sebastopol in 1855. The patient survived the injury eight hours. As in the former instance, the edges of the opening of entrance are sharp and defined, while that of exit (fig. 755) is larger and more irregular. The bullet in this case struck the head obliquely, and hence the elongated form of the opening, closely approximating to the outline of the conoidal projectile in one of its longer diameters. The chief part of the bone carried from the entrance wound into the cranium was again carried out of the cranium through the exit wound with the bullet, for only a few small spiculæ were found inside the cranium after death. This fact no doubt influenced the size and shape of the aperture of exit. The fissure joining the two apertures, and the fissures radiating from the apertures

Fig. 752.



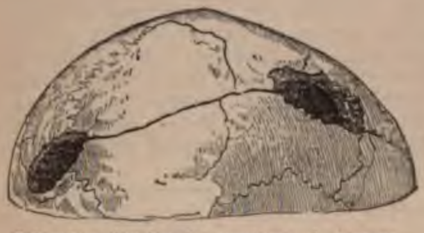
Calvarium showing the opening of entrance of a round pistol-ball. (From a preparation in the Army Medical Department Museum at Netley.)

Fig. 753.



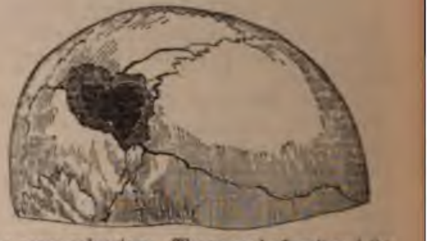
Calvarium showing the opening of exit of a round pistol-ball. (From the same preparation as the adjoining sketch.)

Fig. 754.



Calvarium showing the apertures of entrance and exit made by a rifle-ball. (From a preparation in the Army Medical Department Museum at Netley.)

Fig. 755.



The same calvarium. The wound of exit and the long fissures extending from it are shown in this view.

themselves, indicate the great commotion to which the whole of the wounded side of the calvarium has been subjected. The greater amount of "starring" at the wound of exit is probably in part due to diminished momentum in the projectile.

An important point in practice is that, when a bullet penetrates the cranium, the condition of the opening in the inner table differs from that in the external table, inasmuch as it is always larger, more jagged and irregular in outline, and usually exhibits several cracks proceeding from its margins. Sometimes segments of the inner table are completely detached from the neighborhood of the wound of entrance. The extent to which these conditions may exist varies considerably in different cases, and cannot be diagnosed from any external appearances in the outer table.[1]

[Mr. Teevan has shown by his investigations, that the difference in the extent of fracture in the two tables of the skull is not due, as we were taught for so many years to believe, to the greater brittleness of the internal or vitreous table. The aperture of exit is always larger than the aperture of entrance, whether the bullet passes from without inwards or the reverse. It takes place in obedience to a well-known physical law, that fracture always "*commences in the line of extension, not that of compression.*" He illustrates this by what we see when a thin sheet of ice is under pressure; the cracks or fissures always begin on the under surface, or in the line of extension, or where a stick is bent over the knee, fracture of the wood begins on the distal side of the curve, opposite to the spot where the knee or the force is applied.

The very small particles of bone which a bullet carries with it in its passage through the bone would not appreciably influence the shape and size of the aperture of exit. If the fracture is produced by a bayonet or the prongs of a pitchfork or some similar body which *perforates* the bone, we find the opening in the internal table larger, more jagged, and widely splintered. The same physical law which Mr. Teevan has pointed out obtains here.

It is doubtful whether the *direction* of the violence, as Mr. Erichsen suggested, or the diminished momentum of the projectile, has any influence on the shape and increased size of the opening of exit.]

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[1] This particular subject has been examined very fully by W. F. Teevan, F.R.C.S., of the West London Hospital. See "Experimental Enquiries into certain Wounds of the Skull," etc., by him, in the Brit. and For. Medico-Chirurgical Review, for July, 1864, and July, 1865.

Table of 308 Cases of Foreign Bodies in the Brain.

Description.	No. of cases.	Body removed.	Body not removed.	Recovered.	Died.
Result of gunshot injury. . .	272	86	...	54	32
		...	186	70	116
Result of injuries other than gunshot	36	18	...	13	5
		...	18	4	14

From the above table it will be seen that in 104 cases where the foreign body was removed, 68 cases recovered and 36 died. In 204 instances the body was not removed, 73 recovered and 131 died. In the cases reported as "injuries other than gunshot," the foreign bodies were knife-blades, splinters of wood, wire, nails, etc.]

GUNSHOT WOUNDS OF THE SPINE.

Gunshot wounds of the spine are closely associated with similar injuries of the head. In both classes, corresponding considerations must be entertained by the surgeon in reference to the important nerve-structures, with their membranes, which are likely to be involved in the injury to their osseous envelope; in both, the effects of concussion, compression, laceration of substance, or subsequent inflammatory action, chiefly attract attention. As met with in warfare, the injuries of this region when accompanied with fracture, almost always, sooner or later, entail fatal results; when recovery does take place, the fracture has usually been confined to one of the apophyses of a vertebra, generally the spinous, and has been the result of the stroke of a bullet or other small projectile. Concussion of the spinal column, leading to paralysis more or less persistent, is not unusually occasioned by fragments of shell or large projectiles of the indirect kind; but in these cases the accidents are mostly accompanied by extensive lesions of the neighboring structures. Wounds of the spine from heavy direct projectiles, such as cannon-shot, being almost without exception immediately fatal, are not distinguished in the surgical returns; they only appear in the general list of killed in action.

In the Surgical History of the Crimean Campaign, thirty-two cases are noted in which vertebræ were fractured, ten being without apparent lesion of the spinal cord, and twenty-two with evident lesion. Of these twenty-eight died; and four, in which the fractures were confined to the processes of the vertebræ, survived to be invalided. Dr. Chenu's returns show that out of 194 fractures of bones of the vertebral column in the French army caused by bullets or shell, 181 men died, 11 survived to be pensioned, and 2 returned to duty. In the two latter instances the sacrum had been fractured. Six men only, who had been wounded in the vertebral column during the Sepoy mutiny in India, arrived at Chatham. In all, the wounds were the results of musket-balls. Two were wounds of the sacrum; in the remainder, the portions of the vertebræ fractured were the spinous processes. In the Circular issued in 1865 from the Surgeon-General's office at Washington, it is stated that of 187 recorded cases of gunshot fracture of the vertebræ, all but seven proved fatal. Six of these were fractures of the spinous or transverse processes; the seventh was one in which a musket-ball fractured the spinous process of the fourth lumbar vertebra, and penetrated the canal, but was extracted with the fragments of bone. In one fatal case in the Crimea, the ball passed through the spine rather below the first dorsal vertebra, leading to complete loss of sensation and voluntary motion below the seat of injury, and death on the sixteenth day afterwards; in another, the rifle-bullet entered the right side of the second lumbar vertebra, traversed the spinal canal at that part, and lodged in the body of the bone. In this latter case, violent pain was complained of in the lower extremities, shooting along the groins. The patient was paraplegic, and death ensued thirty-three hours after admission. In another fatal case, a rifle-bullet passed through the right cheek, and lodged near the base of the skull. There was no paralysis, but delirium and coma supervened, and the patient died five days after receiving the wound. The bullet was found after death, lying just below the basilar process, and a large piece of the atlas was broken off and almost detached. The spinal cord did not appear to have been primarily injured; but acute inflammation had been set up, and had extended to the membranes of the brain. There is a preparation in the Museum at Fort Pitt, which shows a gunshot fracture both of the atlas and axis, without lodgment of the ball. The patient survived thirty days. It is curious that, in a case which was under the care of the writer in the Crimea, where a rifle-ball passed through the right loin, entered the spinal canal between the third and fourth lumbar vertebræ, breaking the laminæ, passed upwards within the column, between it and the cord, and made its exit through the left intervertebral foramen between the second and third vertebræ, as shown after

Authority.	Injury.	Cases.	Deaths.	Per ct.	Recovery.	Discharged.
Surg. Rep't, Cir. No. 6, S.G.O., 1865, p. 9	Gunshot Fractures and injuries of cranial bones	704	505	71.7		
T. P. Matthew, Staff Surg. B.A., Crimean War	Gunshot wounds of head, of which 230 are contusion, fracture, penetration, or perforation .	898	170	73.9		
M. Chenu, Crimean Report	Fractures, undetermined wounds, simple wounds and contusions . . .	2774	764	27.5		
M. Chenu	Gunshot fractures of the cranium	731	541	74.		
M. Chenu, Austro-Franco-Italian War of 1859	Wounds of head from all causes—contused, complicated, undetermined, contusions, and unspecified (*sans indications*) injuries	779	456	58.53		
	Contused wounds from musket-balls	233	2	.8		
	Contused wounds from shell fragments . . .	12	3	25.		
	Contusions from musket-balls	52	3	5.7		
	Contusions from cannon-balls or shell fragments	11	11	100.		
	Undetermined wounds from small projectiles .	43	4	7.5		
	Undetermined wounds from large missiles . .	10				
	Complicated wounds from musket-balls	212	111	47.4		
	Complicated wounds from cannon-balls or shell fragments	22				
Inspector-Gen. Mouat in New Zealand War	Scalp wounds	20	......	...	...	20
	Injury of cranial bones .	5	......	...	2	3 for disability.
	Fractures of cranium with wounds of brain . . .	11	11	100.		

Authority	Injuries.	Cases.	Deaths.	Per ct.
Macleod, statistics of Crimean War	Scalp wounds	630	8	1.1
	Fracture of cranium without known depression	61	23	37.7
	Fracture with depression	74	53	71.6
	Penetration of skull	67	67	100.
	Perforation "	19	16	85.7
	Total	851	167	
Alcock	Fracture	28	22	78.5
Ménière, War in India	Penetrating wounds of skull	9	7	84.4
"	" " "	10	10	100.]

Wounds of the head without fracture of bone.—These may consist of contusions without an open wound, or may be accompanied with an open wound.

Contusions of the integuments of the cranium rarely result from direct projectiles, but are frequently met with from those of the indirect kind. The force of a rifle-ball must be very nearly expended before striking the head to produce only an injury of this nature. When a soldier is brought to a surgeon with a history that he has been struck by a fragment of shell, a piece of stone from a parapet, or some unknown projectile, especially when the immediate force of the injury has been partly broken by the man's shako intervening, if no symptoms of compression exist, and those of concussion are moderate or passing off, if on examination only ecchymosis of the scalp can be distinguished, the hope may be entertained that the injury is limited to the obvious contusion of the integuments. The absence of symptoms of compression, together with the history of the injury, must be the chief source of belief that no complication exists, but even these facts cannot be wholly relied upon for indicating that no fracture has been caused by the blow. The diagnosis of gunshot injuries of this order, if the contusion be severe, must always contain elements of uncertainty.

But contusions of the head, though uncomplicated with fracture and apparently slight in nature, when they happen from gunshot, are by no means injuries to be lightly regarded. The amount of bruising obvious to sight, and the degree of cerebral concussion, may have seemed trifling, and yet the remote consequences may be serious enough. Examples of this are frequently seen among military invalids. Soldiers who have been so little overcome by the effects of a wound presenting the symptoms of one of the kind under consideration, that they have been able to walk to a field hospital and themselves to give an account of the injury they have sustained, will sometimes remain under treatment for months, and eventually have to be discharged from service. They may appear robust, their bodily functions may be regular, but without any physical cause obvious to surgical inspection they may still suffer from frequent headaches, occasional fits of nervousness and palpitation, disturbance of some of the special mental faculties, as memory, for example, susceptibility to cerebral derangement from slight sources of excitement, and capricious irritability of temper; and these symptoms may last for years if not for the whole period of life.

Lastly, these contused injuries without breach of continuity in the coverings or fracture of bone, are occasionally accompanied by so much mischief to the encephalon as to lead to a speedily fatal issue. The substance of the brain may be then found to have been torn by the violent movement to which it has been subjected; there may be extravasations of blood without obvious lesion of substance; or its texture may present only signs of congestion. Again, cases have been noted where soldiers have died immediately after such an injury as a stroke from a heavy fragment of shell in the head without fracture of cranium, and where no cerebral lesion has been perceptible to sight at the post-mortem examination. Perhaps in such cases the sudden destruction of life may be due to molecular changes throughout a great part of the nerve-structure, or there may be lesion, though unappreciable, at some part of the brain from which nerves controlling actions essential to life take their origin. It has been argued that such cases are really cases of contusion of the brain, in consequence of the organ having been compressed and injured by momentary alteration in the shape of the skull, which, it has been alleged, can take place in consequence of the elasticity of the cranium.

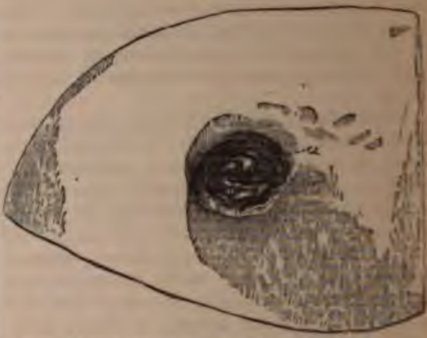
[The suggestion first made by Mr. Liston may explain the cause of death in some of these obscure cases, where no lesion of the brain, its vessels, or its membranes is found after death. When a severe blow is inflicted on the skull, he says, "the brain is separated from its cranial attachments, both at the point struck, and at the part directly opposite; it is thrown upon itself towards its centre, its substance is thereby condensed, its diameter in the direction of the impulse diminished, and a separation between the brain and cranium is found at each extremity of that diameter." By post-mortem examination, it has been ascertained that condensation of the substance of the brain does exist in cases of severe concussion.]

Open wounds of the integuments of the cranium without fracture are usually inflicted by projectiles which are brought into contact with the head at a very acute angle, so that not only is bone not broken, but little direct injury to the brain or its membranes is inflicted, and the surgeon's attention need only to be directed to the same considerations as must occur in any open contused wounds of the scalp from other causes than gunshot. But serious cerebral concussion, and other lesions, such as denuding the bone of its periosteum, are occasionally met with in these accidents. In the former case, the usual stupor and other signs of concussion may be very evanescent, or may last for several days, disappearing gradually and wholly, or entailing subsequent evils at more or less remote periods. When the pericranium as well as the scalp is removed by a musket-ball, superficial as the injury may still seem, there must always be, not only a certain degree of injury and bruising to the bone from which it is torn, but also some laceration of the vessels which inosculate with the nutritive capillaries of the diploë, and through them of the vessels of the meninges with which they are connected. The injury to this vascular system almost invariably leads to necrosis of the portion of the skull from which the coverings are carried away; and sometimes, even when the pericranium is not torn off, sufficient injury is inflicted to lead to a like result. The death of bone is generally limited to a thin layer of the outer table, which in due time exfoliates, and cicatrization follows. But after exfoliation has taken place, and the wound in the scalp has healed, liability to headache, tendency to giddiness, inability to wear a shako, or to bear exposure to a tropical sun, are frequent consequences which unfit the patient for performing military duty.

The injury which occasionally happens in these cases to the vessels ramifying between the inner surface of the cranium and the dura mater may entail serious results of other kinds. There may be rupture of a sinus, leading to compression, or fatal results may ensue from inflammation and suppuration. The case of a young soldier in whom the longitudinal sinus was thus ruptured occurred to the writer. In this instance a rifle-ball had divided the scalp and pericranium about four inches in length obliquely across the skull, just anterior to the angle of the lambdoidal suture, the posterior end of the sagittal suture being exposed midway in the line of the wound. The patient vomited at the instant of the blow, and symptoms of compression, mixed with some of concussion, soon followed. He died eleven hours after the injury. At a post-mortem examination, the superior longitudinal sinus was found to be ruptured, and about four ounces of coagulated blood were lying on the brain. Two darkly-congested spots were observed in the cerebrum, one on each hemisphere, corresponding with the line of direction in which the ball had passed, and these, when cut into, presented the usual characters of ecchymoses. There was no fracture of bone. The case may be found detailed at some length in the Lancet, Vol. I., 1855. When inflammation follows the superficial passage of a ball, whether terminating in resolution or leading to abscess, the symptoms will be similar to those of the same affections from other causes, such as are met with in civil practice, and no special considerations are involved in them. In like manner, the occurrence of erysipelas, and other complications to which such wounds of the scalp are liable, will be found treated elsewhere. (See INJURIES OF THE HEAD, Vol. I.)

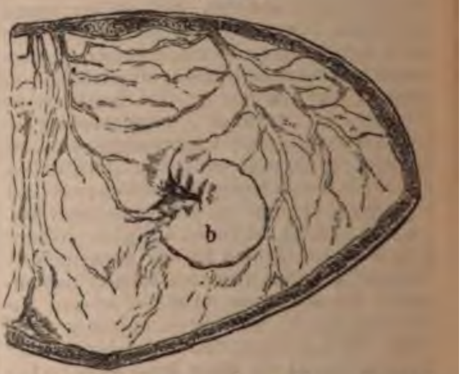
Wounds complicated with fracture, but without marked depression on the cerebrum.—These are very varied in their effects, and often apt to mislead the surgeon, from the absence of urgent symptoms in their early stages. When these accidents occur without an open lesion of the integument, and the fractures are of moderate extent, in consequence of their being almost necessarily accompanied with a great amount of subtegumentary ecchymosis, the diagnosis is rendered very difficult, and sometimes must remain without being established until a late stage of the case, or until death affords the opportunity of demonstration. Figures 756 and 757, represent an interesting example of this class of injury; they are drawn from a specimen (No. 2884) in the Army Medical Department at Netley Museum. The preparation, which consists of a portion of the left parietal bone exhibiting a healed fracture, was taken from a soldier of the 80th Regiment, who received a severe contusion of the head from a round shot at the battle of Ferozeshah, in 1845. When first surgically examined after the wound, there was found to be great tumefaction from ecchymosis, but there was no breach in the scalp, nor was there any marked disturbance of cerebral function. No fracture was detected. Suppuration and exfoliation of the outer table to a limited extent followed, after which the patient recovered, and returned to his duties as a

Fig. 756.



Portion of a parietal bone showing (*a*) depression after exfoliation of a small portion of the external table. The appearance at *a* is partly due to some adherent fibrous tissue which has been dried *in situ* in the preparation.

Fig. 757.



Interior view of the same segment of bone, showing at *b* a healed fracture of a portion of internal table.

soldier. In June, 1851, the man died of dysentery at Dinapore. It was then discovered that there had been a fracture of the internal table. Its seat corresponded with the indentations which had been left after the exfoliations from the external table. The edges of the broken bone had become smoothed off, and were reunited to the old bone. Mr. Taylor, then surgeon of the 80th Regiment, who made the post-mortem inspection, has recorded that "there was a slight depression in the cerebral substance and membranes of the brain opposite to the seat of fracture, and that this part of the brain presented a dark and vascular appearance, but there was no thickening of the membranes nor any traces of effused lymph."

If the cranial fracture, under similar circumstances of the integuments being unopened, be extensive and comminuted, the nature of the injury is obvious enough on first examination, but in such cases death is usually instantaneous. The case of an officer, who was thus killed by a round shot, is mentioned in Dr. Macleod's Notes of the Crimean War. The scalp was not cut, almost uninjured, but the skull was most extensively comminuted.

When, however, the integuments are laid open, and the existence of fracture can be detected by the finger, its occurrence is sufficient to show the force with which the projectile has struck the head, and should serve to indicate the mischief which the brain and its immediate coverings have not improbably sustained, whether cerebral symptoms are present to attract attention, or whether they exist only in a moderate degree, or are wholly absent.

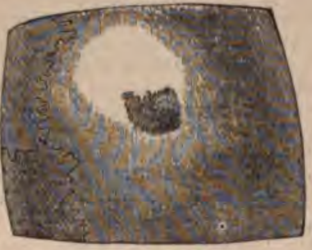
The usual varieties of these gunshot fractures without depression consist first, of simple furrowing of the outer table without injury to the inner; secondly, of fissure extending through both tables to a greater or less degree of length, or of several fissures in distinct lines; thirdly, of splitting of the internal table without fracture of the outer table; and fourthly, of comminution of both tables at the place the ball has struck, in such small portions that they lie loosely on the dura mater, without pressure or much alteration in the general outline of the cranial curve. The chief and only means in many cases of concluding that no depression upon the cerebrum has taken place, is the absence of the usual symptoms of compression; for it is well known that simple observation of the injury to the outer table, whether by sight or touch, will by no means necessarily lead to a knowledge of the amount of injury, or change of position, in the inner table. All that we have a right to conclude is that the brain is not pressed upon to such an extent as to interrupt its functions.

When simple removal of a portion of the outer surface of the skull has been caused by the passage of the ball or other missile, the wound will occasionally, but very rarely, heal without any untoward symptom. When such a wound terminates so favorably, a layer of the exposed surface of bone usually exfoliates, and the granulating surface gradually becomes cicatrized. But such injuries may be, and, indeed are, generally followed by inflammation which extends through the diploic structure, and then not improbably abscess results between the internal table and dura mater; and further as a consequence of vascular supply through the diploë being stopped, and perhaps also partly from the effects of the original contusion, necrosis of the inner table itself may follow. Care must be taken not to mistake an injury of this sort, when it is first presented to notice, for a depressed fracture of both tables. This error in diagnosis is not unlikely to happen when the excavation or ploughing through the diploë effected by the projectile is deep and the cut edges of the outer table of bone bordering the excavation are rather sharp.

Fissured fractures, when the fissures extend through both tables of the skull, usually result from injuries by heavy projectiles. The passage of a ball may fracture and very slightly depress a portion of the outer table of the cranium without furrowing it, and then the line of fracture will very closely simulate fissured fracture extending through both tables, and the diagnosis between them be excessively doubtful. When fissured fracture exists, the distance to which it may be prolonged is often quite unindicated by any physical signs or general symptoms, and its extent is consequently very uncertain. A striking example of this fact was furnished in the instance of an ill-fated member of our own profession. Assistant-Surgeon Dr. ———, of the Bengal medical service, was wounded at Lucknow in 1857, by a fragment of shell, just as he was going under a gateway. The missile struck him at the back of the head and inflicted a lacerated wound near the upper part of the occiput. The unconsciousness which immediately resulted from the stroke of the projectile quickly and completely disappeared, and no marked cerebral symptoms followed. He was able to sit up in his bed, and freely talked about his own case and the differences of opinion among his brother officers respecting it. It was thought by some that fracture existed; but others, from the absence of symptoms and from no evidence of its being afforded from examination by the finger or probe, were of opinion that there was no fracture. The wound was inflicted just toward the termination of the siege, and a few days after its occurrence Dr. ——— had to be removed with the garrison to the Dilcousha palace. This march seemed to disturb him considerably, and a day or so after his arrival there he died; extensive fissured fracture of the cranium was then discovered. Such fissures may occur at parts remote from the spot directly injured. In the case of a lieutenant of the 11th Hussars, who was apparently slightly wounded at Balaklava in the middle of the forehead by a piece of shell, a fissured fracture was found after death across the base of the skull, quite unconnected with the primary wound, and seemingly from *contre-coup*. Death resulted from inflammation and suppuration set up near this indirectly injured part after he had left the Crimea.

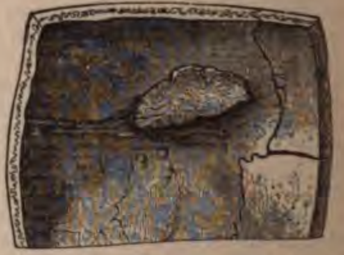
Fissured fracture of the inner table, without external evidence of the fracture, is a rare accident, but certain instances of it have been noted. Such a case occurred in the 55th Regiment in the Crimea. The soldier had a wound of the scalp along the upper edge of the right parietal bone. The ball in passing had denuded the bone; but there was no depression, nor appearance of fracture. The man walked to camp from the trenches without assistance, and there were no cerebral symptoms on his arrival at hospital. Five days afterwards there was general œdema of the scalp and right side of face, the wound became unhealthy, and slight paralysis of the left side was noticed. The next day hemiplegia was more marked, convulsion and coma followed, and he died on the thirteenth day after the injury. Pressure from a large clot of coagulum, and extensive inflammatory action, were the immediate causes of death; but a fissure, confined to the inner table, running in line with the course of the ball, was also discovered. A preparation of the calvarium in this case was presented by Dr. Cowan, 55th Regiment, to the Museum of the Army Medical Department, and is now in the collection at Netley. Dr. Demmé has recorded that he saw four cases which occurred during the campaign of 1859, in Italy, in which injury to the internal table was discovered by examination post mortem, when there was no apparent injury to the outer table, and in one of these, two inches square of the inner table had become detached. Eight examples of this interesting variety of cranial fracture, which occurred during the late war of the rebellion in the United States, are preserved in the Army Medical Museum at Washington. [Twenty cases of fracture of the internal table alone, are reported by Dr. Otis. One recovered.] One of these was very similar to the Crimean case detailed above. There were no signs of cerebral disturbance for seven days, when symptoms of compression supervened, and death followed. A fracture of the internal table of the left parietal bone was then discovered. The dura mater had been wounded by the sharp edge of the fissured bone, and abscess had occurred in the left cerebral hemisphere. The following drawings (figs. 758, 759) illustrate another case in which a fragment of the inner table of the frontal bone, an inch and a half in length by half an inch broad, was completely detached, without there being any fracture of the outer table.

Fig. 758.



Exterior view of a portion of frontal bone with outer table contused, but not fractured.[1]

Fig. 759.



Reversed view of the same specimen with portion of inner table fractured and completely detached.

In a third case, the probability of this kind of lesion having taken place was inferred during life, and trephining was employed. In this instance there was no headache nor disturbance of the cerebral faculties for more than a fortnight after the wound, which appeared at first to be only a lesion of the scalp and pericranium. When the trephine passed the outer table, pus escaped from the diploë, and a fracture of the inner table was then discovered. The patient died the following morning. An abscess had formed in the brain.

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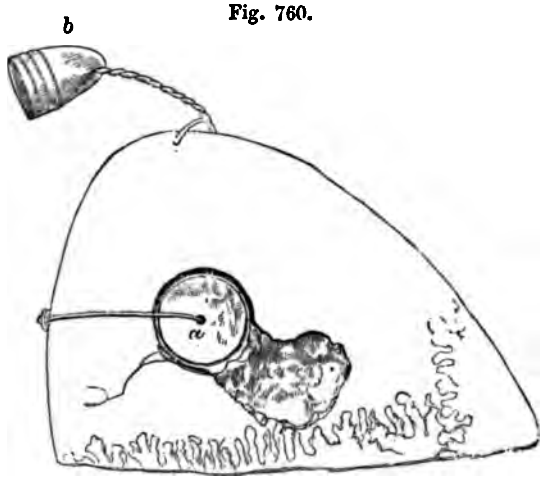
[1] Spec. No. 2313 in the United States Army Medical Museum. See Catalogue of the Surgical Section, p. 8.

The cases where comminution has resulted from the stroke or track of a ball across the skull, generally present less grave symptoms, and are less dangerous as to their results, than those where a single fissured fracture, extending through both tables, exists. The comparatively less unfavorable character of these accidents may arise from the force of the ball happening to be expended locally on the part broken up into fragments, instead of being diffused more generally over the cranium, as probably always happens in the instance of fissured fracture. The more open condition of the wound may also be a source of the comparative immunity from fatal results. The small loose fragments can be removed; and if, what is most important, the dura mater be intact, the case, with proper care to prevent inflammatory action, may not improbably be attended with a favorable recovery.

Wounds complicated with fracture, and symptoms of depression on the cerebrum without lodgment of the projectile.—These gunshot injuries are very serious, and the prognosis must always be unfavorable. They must not be judged of by comparison with cases of fracture with depression caused by such injuries as are usually met with in civil practice. The severe concussion of the whole osseous sphere by the stroke of the projectile, the bruising and injury to the bony texture immediately surrounding the spot against which it has directly impinged, as well as the contusion of the external soft parts, so that the wound cannot close by the adhesive process, constitute very important differences between gunshot injuries on the one side, and others caused by instruments impelled solely by muscular force on the other. And as happens with the external parts, so also the injury to the brain within, and its investments, is proportionably greater in such injuries from gunshot. The experience of the Crimean campaign shows, that when these injuries occurred in a severe form, they invariably proved fatal. Of seventy-six recorded cases treated in hospital, in which depression of bone only existed, without penetration or perforation of the cerebrum by the projectile, fifty-five proved fatal. In the twenty-one survivors, the amount of depression is stated in the surgical history of the campaign to have been slight; yet of these, twelve had to be invalided out of the service, and nine only were discharged to duty. [In the table, p. 465, copied from the Surgical History of the War of the Rebellion, 364 cases of depressed fracture of the cranium are reported, with a mortality of 35.8 per cent. It is difficult to understand this comparatively small mortality, when compared with the report of 2911 cases of fracture without depression, with a death-rate of 64.6 per cent.]

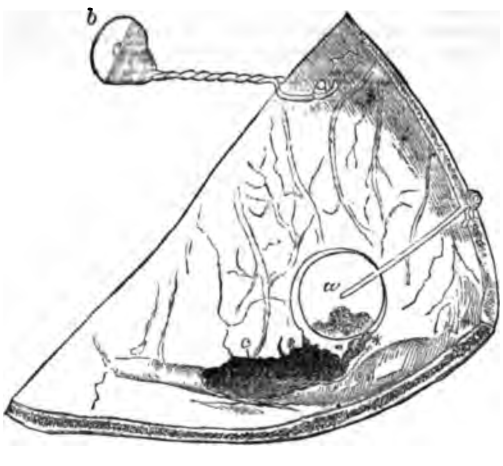
With depression and lodgment of the projectile, without or with penetration of the cerebrum.—It is obvious, that where a small projectile, having power not only to fracture but also to depress a portion of the cranium, becomes lodged, it will not usually be arrested in its progress at the opening it has made, but more frequently will pass on to a greater or less depth beyond it. It is, however, sometimes stopped at the seat of fracture. It may then be found to be entire, though flattened by the effects of the opposition it has met with from the strong and arched cranium, and by its violent collision with the fragments of the bone it has broken, and among which it is caught and retained; but more often it is found to have been held back by other causes beside the simple influence of the resistance it has met with in causing the injury, and to be partially or wholly divided. The generally rounded form of the cranium causes it to be penetrated by small projectiles only comparatively rarely in a line directly perpendicular to the part struck. Usually the projectile and the cranial surface come into collision with each other obliquely, at angles varying, however, greatly in their degrees of acuteness. Hence it happens, when a missile striking the head slantingly has had momentum enough to fracture, and to drive in, to a certain extent, the part of the cranium with which it is first carried into contact, its line of flight becomes deflected by the resistance it has met with into a still more acute angle with the curve of the cranium, after which, proceeding from a somewhat deeper level, its onward movement carries it against the jagged margin of the fixed portion of bone forming the upper boundary of the aperture at the seat of fracture. When this happens, the ball either becomes deeply grooved and retained, impaled, as it were; or a large part of it is retained, while a small portion is separated and carried onward: or it is completely divided into two parts by the sharp and hard edge of the broken bone. In this last event, the upper half of the ball may escape altogether, or be caught between the scalp and outer surface of the cranium; the inner half, in like manner, may lodge between the under surface of the cranium and dura mater, or, piercing the dura mater, may lodge in the cerebrum. Every campaign furnishes a series of examples of these accidents.

Fig. 760.



External view of a segment of a parietal bone with depressed fracture. *a.* Portion of bone removed by trephine. *b.* Half of the rifle-ball found in the cerebrum.[1]

Fig. 761.



Interior view of the same preparation. *a.* Portion of bone removed by trephine. *b.* Half of the rifle-ball found in the cerebrum. *c.* Splintering of internal table extending to the situation of the longitudinal sinus.[1]

Figures 760 and 761 will serve to illustrate one of these accidents, which occurred in the writer's practice. The case presents several features of interest. The patient, a young soldier, was brought up from the trenches before Sebastopol in a state of coma. He had been struck on the head by a bullet. There was fissured fracture and slight depression, but no hole in the skull. Trephining was immediately performed, without any relief of symptoms following, and the patient died on the same day. At the post-mortem inspection, half the rifle-bullet which had inflicted the injury was found in the brain, just above the orbital plate of the frontal bone on the same side. The divided surface of the bullet presented as smooth a surface as if it had been cut by a sharp knife. In this instance there was no evidence during life of a foreign body having penetrated the skull; as soon as one half of the bullet had entered, the door through which it had forced admittance became closed; the other half of the bullet escaped altogether. Did the depressed portion of bone spring up and close the opening of entrance by its own resilience, or was this closure aided by the resistance and counter-movement of the brain from within?

The usual result, however, when a depressed fracture is caused by a rifle-bullet at ordinary speed, is that the whole of the projectile together with splinters of bone are carried through the membranes into the cerebral mass. Sometimes a ball, if not making its exit by a second opening in the cranium, will lodge at the point of the cerebral substance opposite to that of its place of entrance, but the course a projectile may follow within the cranium under such circumstances is altogether uncertain. The instance of a bullet passing into the cranium, through the cerebrum, and escaping by a counter-opening, only occurs when the projectile has struck at full speed and with immense force. It is almost needless to say that any wound of the cranium in which a projectile has effected a lodgment in the substance of the cerebrum, however near it may be to the surface, possesses characters of the utmost fatality. Of eighty-six cases in which either penetration or perforation of the cranium occurred in the Crimea, all died.

[Reference to table on page 465, shows a greater fatality attending cases of penetration, than of perforation of the cranium. The ratio of mortality in penetrating fractures being 85.5 per cent.; in perforating fractures 80 per cent.]

Rare instances have occurred where balls have lodged in the cerebrum, without giving rise to serious symptoms of danger for a long time. Such exceptional cases might lead to throwing surgeons off their guard in making a prognosis, from supposition that the ball by some accident had not lodged. The case of a soldier wounded in Canada by a ball in the posterior part of the side of the head is mentioned by Mr. Guthrie. The wound healed, and the man returned to duty; a year afterwards he got drunk, and died suddenly. The ball was found in a sac, lying in the corpus callosum. Another soldier wounded at Waterloo had a similar recovery, and also died after intoxication. The ball was found deeply lodged in a cyst in the posterior part of the brain. In the Museum at Netley there is part of a cranium which was perforated by a musket-ball, also at Waterloo. The history states that the bullet penetrated and lodged, but that the patient became convalescent. "He was attacked with apoplexy fifteen weeks after the wound, and died. The ball was found loose in the lateral ventricle, having shifted from its original position." What the latter position was, is not recorded. An artillery soldier was wounded in the Crimea by a rifle-ball, which entered near the inner angle of the left superciliary ridge. The wound progressed without a bad symptom, until a month afterwards, when coma came on, and death shortly followed. The ball was found in a sac, in which pus also was contained, at the base of the left anterior lobe of the brain.

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[1] Spec. No. 2883 in the Army Medical Museum at Netley.

In the year 1861 the writer attended an officer whose history left little doubt that he was then suffering from the effects of a musket-ball lodged in the brain. He had received his wound before Delhi, in September, 1857. The medical officers who attended him immediately after the injury, reported that a bullet had made an opening through the posterior and inferior portion of the left parietal bone, that the dura mater was penetrated, that brain substance had been forced out at the opening in the cranium, and that the ball had passed out of sight and was probably lodged deeply. The nature of the opening, which was covered over by fibrous investment and the scalp at the time I examined it, indicated the direct passage of the projectile; for it was regular, nearly circular in shape, and the edges of the bone around could be felt to be even and straight—not shelving as happens in a fracture from a ball striking obliquely. The opening was depressed when the brain was in ordinary action; but, under excitement, or on stooping, the depression became filled up by the brain from below. The symptoms at this time, three years and a half after the wound had been received, were: imperfect memory; imperfect power of vision, not to an extent to incapacitate him for ordinary work, but chiefly noticed on continued visual exertion, such as on trying to read much; occasional headache and dizziness; neuralgic pain about the muscles of the back of the neck; partial loss of sensation and of voluntary power in the arm and fingers on the side opposite to that of the wound, the right; and inability for any exertion or excitement leading to determination of blood to the head. This officer was, of course, unfit to serve in a hot climate, or to undertake any such active exertion as would be necessary in a campaign, but by living in the most abstemious manner, and by strict regimen, he was enabled to discharge certain home military duties until the year 1868. During the unusually hot summer of that year, a state of stupor came on, and gradually increased until he died. No post-mortem inspection was permitted.

Treatment.—One of the first lessons to learn as regards the treatment of a gunshot wound of the head is the propriety of abstaining from surgical interference when the case is first brought to the surgeon. When a soldier is rendered insensible by a severe injury to the head, the patient presents an appearance so nearly allied to that of approaching death, that an instinctive desire to do something with a view to arrest a fatal termination seizes upon those in whose charge the patient is placed. One may choose to administer stimulants, another to bleed, and each, if his treatment be carried into effect, may cause irreparable mischief to the wounded man.

All that the surgeon stationed at a first line of surgical assistance need do, when a soldier unconscious from such an injury is brought before him, is to ascertain that the chest and throat are rendered free from all constriction by his uniform, so that the centre of circulation, and the respiratory apparatus, may have the fullest opportunity of recovering from the shock to which they have been subjected; to warn the bearers that the patient is to be kept strictly in the horizontal position throughout the transportation to hospital, and to be carried with as little shaking as possible; to put them on their guard as to the not improbable occurrence of vomiting; and to order the man's great-coat to be thrown over the lower extremities to keep up warmth and circulation in them as far as practicable. The man's knapsack, if he was carrying one, should not in this case be put under his head: the object is to keep the head level, so that the blood may flow to and from the brain with the least difficulty while the circulation is enfeebled. If a vessel of the scalp be bleeding, a small pad of lint and pressure against the skull by means of a bandage will generally suffice to stop it; not always, however, for it has happened to the writer not to be able to arrest the bleeding of a divided artery hanging patulous from among the torn and contused tissues, neither by pressure, nor by torsion, nor exposure to cold, and a ligature has had to be placed on both divided ends.

When the patient has reached the field hospital, the horizontal position being still maintained, an attendant should shave the hair from the head around the seat of injury, so that a careful examination may be made by the surgeon. As in all other gunshot wounds, the examination should be made as early as possible, and as soon as the surgeon has satisfied himself as to the nature of the wound, the patient should be kept quiet, that he may gradually recover from the state of concussion and collapse, in which he will still probably be found at the time of his arrival at the hospital.

[When the depression of the powers of life is great, and there is danger of death from shock, as frequently is the case after such injuries, the head should be slightly elevated, warmth applied to the body, and some diffusible stimulant cautiously administered; by the mouth if the patient can swallow, if not, by the rectum, or hypodermically. Ammonia or brandy or wine may be given, the first being less permanent in its effects and probably preferable on this account. The surgeon should keep in view the fact, however, that the reaction is generally in proportion to the depression, and inflammation and its effects are sure to follow; and as soon as the danger from collapse passes off, the head should be farther elevated, and the warmth and stimulants withdrawn. Laceration of the brain may also be present, and injudicious stimulation encourages internal hemorrhage.]

It will be convenient to consider the treatment to be adopted in each of the varieties into which these wounds have been classified.

Wounds without fracture of bone.—Supposing that the effects of contusion of the scalp are alone exhibited, the application of cold water-dressing, cold affusion, or ice bladders, if they can be obtained, to the head, is the only local treatment required. Whatever may be the extent of ecchymosis, and whatever its form, whether it be beneath the tendon of the occipito-frontalis muscle or diffused beneath the skin, the swelling should on no account be incised; an opening will take away all chance of the effused blood being absorbed. If the effusion be extensive, suppuration is not unlikely to occur under any circumstances, and then opening is unavoidable, but every effort should be made to prevent it at the onset. It is occasionally recommended by Continental surgeons to make strong pressure upon the protuberances caused under such circumstances, with a view to cause the dispersion of the blood in the cells of the neighboring areolar tissue. A piece of thin metal, placed in a compress, the pressure being maintained by a tight bandage, is the plan sometimes adopted for the purpose. But considering the situation of the injury, this mode of treatment appears to be neither so scientific nor likely to be so generally useful, as moderate pressure with appropriate cooling remedies. The thick and voluminous bandaging occasionally placed around a patient's head, with the intention perhaps of keeping the wet lint which has been applied to the injured part in its place, is also very objectionable, because it tends rather to promote than to prevent suppuration. Such restraining bandages should always be of the simplest and lightest character. Nothing can be better for the purpose than the six-tailed head bandage, especially when it is made of fenestrated linen to ensure additional coolness.

The general treatment should be all directed to limiting the amount of reaction, and preventing inflammatory action among the important structures in the immediate neighborhood of the seat of injury. This applies to the general treatment of every wound of the head, however trivial and however severe; and most especially in cases where the injury has been caused by the stroke of a direct projectile. An active purgative should be administered. The utmost abstemiousness as regards diet and drinks should be enjoined. In no injuries is the importance of abstinence rendered so manifest by the ill consequences of its neglect, as in injuries of the head. Excitement and disturbance of all kinds should be avoided. If the injury be apparently a slight one, the surgeon may find it very difficult to enforce the regimen here indicated; but, for some days at least, however urgent may be the appeals of the patient, he should by no means give his consent to the rules laid down being infringed. Apparently slight as the injury may be, a slight excess may quickly convert it into a serious one.

The same treatment, local and general, is applicable to cases in which the only difference is the existence of an open wound. When caused by small projectiles, these scalp wounds are usually furrowed wounds, scooped out, as it were, their whole length; but sometimes the bullet, after entering the scalp, travels along some distance between it and the cranium, and makes a tunnel-like passage between the two structures before effecting its exit. In this latter case, in addition to the other treatment, occasional syringing the passage beneath the scalp with tepid water is useful. It carries away sloughs or discharges, and often removes small hairs which have been driven in by the projectile and act as sources of irritation in the wound.

Wounds, with fracture, without marked depression.—There should be no difference in the early treatment, even if below the contused scalp, or if more obviously through an open wound, there be distinguished a fracture of bone. The rules for preventing all disturbance, both bodily and mental, will be more imperatively necessary than in the previous cases, on account of the greater amount of injury which has been manifestly effected, with the closer contiguity and more direct connection of the injured parts with the brain; but no operative interference should be resorted to. There are reasonable grounds for hopes, deduced from experience, that, notwithstanding a fracture may exist, recovery may ensue without any surgical interference being had recourse to beyond the local treatment already described. Prudence dictates that with this simple treatment the patient should be very carefully watched, so that symptoms of compression may be noted at their earliest onset. In a case of this order intracranial extravasations from lesions of bloodvessels may occur suddenly, or, if the reaction be excessive, inflammation may rapidly be induced, and then the necessity of further surgical interference will have to be considered without delay.

Wounds, with fracture, and marked depression.—The treatment of these wounds, in which there is not only a compound fracture, but the broken bone is depressed upon the encephalon, requires more particular consideration. It involves the question of the propriety of trephining in any gunshot wound, for if the operation is to be performed at all, it must be most called for in those cases where depression of bone is obvious, and the usual effects of compression upon the brain are equally manifest from its influence on the whole frame of the patient.

The importance of the question makes it advisable to take a brief survey of previous opinions concerning this operation, and of the results of the experience recently gained respecting it.

Formerly, a gunshot wound of the head was supposed to be in itself a sufficient indication for the use of the trephine; indeed, even where no fracture was caused, an opening was recommended not many years ago by some surgeons to be made in the cranium, to meet symptoms which might be expected to result after such an injury as a severe contusion from a musket-ball. Such preventive trephining has been proved to be useless, as well as dangerous, and is universally acknowledged not to be an admissible operation. The majority of English military surgeons after the period of the Peninsular war limited the use of the trephine to cases where one of the three following conditions was supposed to exist: first, where depressed bone was causing interruption of cerebral function; second, where fractured bone had penetrated the cerebral substance; and third, where an abscess had formed within reach, and was capable of evacuation. The tendency of the most recent experience in Europe, *i. e.*, within the last fourteen or fifteen years, has been to confine the practice of trephining within still narrower limits than those just mentioned, particularly as regards the first class of cases, in which the interruption of cerebral function appears to be caused by the pressure of depressed bone; and when the very great difficulty of making accurate diagnosis in these cases is considered—whether as to the distinguishing signs of compression; the precise seat of its cause, if the compression exist; the space over which this cause, when ascertained, may extend; its persistent or temporary character; the impossibility of estimating the amount of injury done to the internal table by a musket-ball from the external characters of the fracture; complications as regards deeper injury in the cerebrum; and certain dangers connected with the operation itself,—it hardly seems to be a matter of wonder that this tendency should exist. Besides, the numerous cases which have now been noted where bone has evidently been depressed, but the brain has accommodated itself to the pressure without serious disability being caused, or where compression from effusion has been removed by absorption under proper constitutional treatment, are further causes of hesitation in respect to trephining. In the Surgical Report of the Crimean Campaign, it is stated that the trephine was successfully applied in only four cases during the whole war. There were three other cases of recovery after elevation of depressed bone, in two of these the fragments being raised by an elevator, in the remaining one by the aid of Hey's saw. Out of these seven cases the dura mater was known to have been uninjured in four; in one it was torn and a portion of brain protruded; in the other two its condition was not recorded. In not one of these cases, as far as known, did the injury follow such a violent cause as the stroke of a rifle-ball. Five were caused by fragments of shell, one by the explosion of a magazine; the cause of the seventh injury is not stated. When to the risks already mentioned above, the fact is added that but seven survivals occurred after forcible elevation of depressed fractured bone, four of them only by trephining, in the British army during the whole Crimean campaign; that these took place after injuries from projectiles of comparatively low force and velocity; and that in the majority of the cases the dura mater had not been penetrated; the limited value of trephining in gunshot wounds of the cranium seems to be strongly borne out by the experience of that war. In the French report, by Dr. Scrive, it is stated that trephining was, for the most part, fatal in its results in the French army. In siege-operations, the experience as regards wounds of the head is always very extensive, the lower parts of the body being so much more protected in the trenches. According to Dr. Scrive's returns, one of every three men killed in the trenches before Sebastopol, and one in every 3.4 wounded, was injured in this region. In the English returns, wounds of the head and face in the men are shown as 19.3 per cent; in the officers, as 15 per cent.; but this is of the total wounded in the field as well as in the trenches.

The experienced German surgeon, Dr. Stromeyer, who in the early part of his professional career advocated trephining in complicated fractures of the skull, states in his Principles of Military Surgery, that he has been led to abandon the practice. He has recorded that after the battle of Kolding, in Schleswig, in 1849, there were eight gunshot fractures of the skull, with depression, and more or less cerebral symptoms. In all these, with one exception, the detachment of the fractures was left to nature, and all recovered. The exception was that of one patient, from whom some fragments were removed on the seventh day, and he was placed in such considerable danger by the treatment, that Dr. Stromeyer resolved never to adopt it again. In the following year in Schleswig, two young surgeons came under Dr. Stromeyer's care with gunshot wounds of the head, accompanied by deep depression; they were both treated without trephining, and both recovered. Throughout the three campaigns of the Schleswig-Holstein war, Dr. Stromeyer records that there was only one case of trephining which gave a favorable result. Of eight cases of fracture of the cranium, with displacement of both tables, recorded by Dr. Williamson, among men who were wounded during the Sepoy mutiny in India and who subsequently arrived at Chatham, none had been trephined. In all these there was a depressed cicatrix, the wound having contracted and become closed by a strong fibrous investment. In one case—a wound by a musket-ball in the centre of the forehead—the ball was supposed to be still lodged within the skull. No soldier reached Chatham from India on whom the operation of trephining had been performed. We are not yet aware of the total experience in regard to the practice of trephining during the Italian campaign of 1859, or in the German war of 1866. It appears that in the former war the results of the observations in the Crimea by the French and Sardinian surgeons, and the latest German experience, led to the operation being very rarely resorted to in any one of the three armies engaged. But the experience gained during the late war in the United States, so far as it has been published, has a tendency to unsettle our notions on the subject again. The Surgeon-General's circular issued in 1865, containing Reports on the Extent and Nature of the materials available for the preparation of a Medical and Surgical History of the Rebellion, states that out of 107 terminated cases in which the operation of trephining was employed, sixty died and forty-seven recovered; a ratio of nearly forty-four per cent. of recoveries. In 114 cases fragments of bone or of foreign substances were removed by the elevator or forceps, and of these sixty-one died and fifty-three recovered—a ratio of more than forty-six per cent. of recoveries. But the report further states that "the data are not sufficiently complete to admit of fair comparative analysis; still it is difficult to avoid the impression that a larger measure of success has attended this operation in the late war than the previous experience of military surgeons would have led us to anticipate." It is evident before conclusions can be drawn from the American statistics that the nature of the cases in which the trephine was employed should be known,—in how many the dura mater was opened, and in how many not,—and other such circumstances affecting the results of gunshot wounds of the head. In European military practice the experience of recent years would cause the trephine to be employed only in cases which were otherwise hopeless; perhaps the American surgeons may have applied it with less hesitation in ordinary cases of depressed fracture. At any rate, as the report itself indicates, deductions regarding the effect of this treatment in the United States must be withheld until all the experience has been gathered together, and the medical and surgical history, which is still in progress, of the whole war, is complete.

[The following table is taken from the Surgical History of the War of the Rebellion, vol. i., p. 309:—

Table of the Results of Nine Hundred Cases of Injuries of the Skull in which operations were performed.

Operations.	Cases.	Recoveries.	Deaths.	Undetermined.	Ratio of mortality.	Remarks.
Extraction of missiles . .	175	89	83	3	48.3	The missiles extracted from beneath the scalp or soft parts are not reckoned in this table.
Ligations	33	21	12	...	36.3	
Removal of bone splinters or elevation of depressed bone	454	275	176	3	39.	
Formal trepanning . . .	220	95	124	1	56.6	
Operations for hernia cerebri	29	7	22	...	75.8	

The results above recorded are very different from the reports of English, French, and German writers on this subject, and while, as Dr. Otis states, the exact extent of injury in every case is not known, the statistics go far to prove the very great advantage of operative interference in a large proportion of cases of gunshot fractures of the head. The difference in the experience of American surgeons and military surgeons abroad may be due partly to the fact stated by Prof. Longmore, that the former did not restrict the application of the trephine to otherwise hopeless cases, and to some extent it may be explained by the difference in the effect of the old round-ball and the modern sharp, heavy minié-bullet. With American surgeons, especially those engaged in the late war between the States, there is a disposition to employ the trephine more frequently than they formerly did, and to ascribe the mortality attending its use, rather to the original injury and its effects upon the contents of the cranium, than to the simple operation of trephining. When the fracture is not attended by a wound in the scalp and the bone is only slightly depressed, and no urgent cerebral symptoms are present, such means as favor cerebral accommodation and prevent intra-cranial inflammation, should alone be employed; but when the bone is depressed and comminuted, or the seat of fracture exposed by a wound in the soft parts, or symptoms of compression present, and intra-cranial inflammation apprehended, operative interference is demanded.

In a very valuable paper, published by Dr. S. W. Gross in the American Journal of Medical Sciences, 1867, a comparison is made in the treatment of gunshot wounds of the skull, between the results obtained by trephining and by the expectant plan. In 160 cases, where the trephine was employed, 97 or 60.62 per cent. perished, and in 573 serious cases treated by expectancy, 426 or 74.34 per cent. died. In 126 cases where fragments of bone were elevated or extracted, or foreign bodies removed with the elevator, forceps, or Hey's saw, 70 or 55.55 per cent. were fatal. Comparing these statistics, we find in favor of the last mentioned plan over the operation of trephining, 5.07 per cent. of recoveries. After all operations of every kind the rate of recovery was 41.61 per cent. After the conservative or expectant plan only 25.26 per cent. lived, making in favor of operative interference 16.35 per cent. of recoveries. The above were cases occurring in army practice. In private and hospital practice, in this country and abroad, Dr. Gross collected the records of 252 cases of trephining, and found the mortality 133 or 52.77 per cent.; the death-rate being less than that of army practice by 7.85 per cent.

When an operation is necessary in cases of gunshot fracture of the cranium, the earlier it is done the better. Preventive, rather than curative trephining should be the rule. Prof. W. T. Briggs, in Transactions of the American Medical Association, vol. xxxi., p. 769, says: "Sédillot, in a paper communicated to the Academy of Sciences of Paris, has shown by statistics based on 106 cases collected from various sources, that the mortality following head-wounds was in proportion to the delay in the employment of the trephine. Two-thirds of the cases were saved by the preventive trephine; more than one-third by early trephining; less than one-third by retarded trephining; and one patient only recovered out of twenty-nine cases in which no operation was performed. My personal experience, embracing forty-two operations performed as a prophylactic in recent injuries of the head, with the result of thirty-eight recoveries and but four deaths, strengthen the statement of Sédillot."

In the operation of trephining the conical trephine will be found an improvement on the old instrument. All loose pieces of bone should be taken away entirely, and the wound should be left open; no sutures or adhesive plasters being used, that free discharge of all fluids may take place as soon as formed. In no operation in surgery is perfect drainage more important.]

Military experience in Europe during the present century has made it as difficult to understand the frequent successful results of trepanning by the older civil surgeons, as to find a justification for the use of the operation in such slight cases as those in which they often performed it. The dura mater must have been unopened in most of the cases. Probably also the issues were so successful because the patients labored under little else than the effects of the operation itself, while, as we well know, very fatal mischief usually exists in addition in those instances in which the operation is resorted to by military surgeons for accidents from gunshot. While showing the ill results of operative interference, an occurrence, quoted by Sir G. Ballingall, is worth mentioning, as it particularly illustrates the favorable results of abstaining from trephining in some cases. After the battle of Talavera, a hospital which had been established in the town had to be suddenly abandoned, and an order was given for all the wounded who could march to leave it. There was no time for selection, and among those who marched were twelve or fourteen men with wounds of the head, in which the cranium was implicated, four or five having both tables fractured, and two having the globe of one eye destroyed, along with fracture of the os frontis. All these men recovered, though they were sixteen days on the march, harassed and exposed to a burning sun, and had no other application than water-dressing. [In the Peninsular war referred to, the old round musket-ball was used. The same result could not have been expected if these men had been wounded with the modern conical minié-ball.] In the Netley Museum are several preparations, showing extensive depressed fracture of the inner table of the skull taken from patients who had recovered without trephining, and who died years afterwards from other causes. One only, however, of these specimens has a clear history that the fracture resulted from gunshot. In all these cases the edges of the depressed portions of bone had become smooth, and united by new osseous matter, and the cerebrum must have accommodated itself to the new form of the inner cranial surface.

With regard to those wounds in which there is not only a depressed fracture, but the projectile has passed into the brain-substance, trephining can scarcely ever be of any avail. Two or three instances are recorded in which the course of a ball has been traced from the site of entrance across the brain, and trephining resorted to for its extraction with success; but there are also many others in which the mere operation of the extraction of a foreign body has apparently led to the immediate occurrence of fatal results. Moreover, splinters of bone are almost always carried into the brain when balls penetrate its substance, and these may elude observation; or the ball itself may be divided and enter the brain in different directions, when the operation of trephining can only be an addition to the original injury, without any probable advantage. These are all circumstances to be considered in estimating the propriety of trephining in any particular case.

It is only right to wait until the recent experience in the United States is more fully elucidated; but, until that is before us, the following seem to be the rules of practice regarding this operation in gunshot injuries, which modern European experience tends to inculcate. When irregular edges, points, or pieces of bone, or foreign substances, are forced down and evidently penetrate—not merely press upon—the cerebral substance, or where abscess manifestly exists in any known site, and relief cannot be afforded by simpler means at the wound itself, trephining is a proper operation to be resorted to for effecting the necessary relief; but in all other cases harm will probably be avoided by abstaining from trephining, while benefit will be effected by simply resorting to long-continued constitutional treatment, viz., all the means necessary for controlling and preventing the diffusion of inflammation over the surface of the brain and its membranes; the most careful regimen, very spare diet, strict rest and quiet, the use of antimonials, occasional purgatives, cold applications locally, so applied as to exclude the air as much as possible from the wound, and perhaps depletion by venesection in case of inflammatory symptoms arising. Similar remarks will apply when the case is one of lodgment of a projectile within the brain; if the site of its lodgment is obvious, it should be removed with as little disturbance as possible, but trephining for its extraction when the place of lodgment is not definitely known, but the projectile is only supposed by inference to be lodging in a particular spot beneath the cranium, is an unwarrantable operation.[1]

[The following interesting table, from Agnew's Surgery, vol. i., p. 295, is compiled from a thesis by Dr. H. R. Wharton, University of Pennsylvania:—

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[1] A very elaborate essay, entitled, Étude sur la trépanation du crâne dans les lésions traumatiques de la tête, par M. Hippolyte Baron Larrey (4to, pp. 123, Paris, 1869), which has appeared since the above was in type, may be consulted for further information on this subject.

Table of 308 Cases of Foreign Bodies in the Brain.

Description.	No. of cases.	Body removed.	Body not removed.	Recovered.	Died.
Result of gunshot injury. . .	272	86	...	54	32
		...	186	70	116
Result of injuries other than gunshot	36	18	...	13	5
		...	18	4	14

From the above table it will be seen that in 104 cases where the foreign body was removed, 68 cases recovered and 36 died. In 204 instances the body was not removed, 73 recovered and 131 died. In the cases reported as "injuries other than gunshot," the foreign bodies were knife-blades, splinters of wood, wire, nails, etc.]

GUNSHOT WOUNDS OF THE SPINE.

Gunshot wounds of the spine are closely associated with similar injuries of the head. In both classes, corresponding considerations must be entertained by the surgeon in reference to the important nerve-structures, with their membranes, which are likely to be involved in the injury to their osseous envelope; in both, the effects of concussion, compression, laceration of substance, or subsequent inflammatory action, chiefly attract attention. As met with in warfare, the injuries of this region when accompanied with fracture, almost always, sooner or later, entail fatal results; when recovery does take place, the fracture has usually been confined to one of the apophyses of a vertebra, generally the spinous, and has been the result of the stroke of a bullet or other small projectile. Concussion of the spinal column, leading to paralysis more or less persistent, is not unusually occasioned by fragments of shell or large projectiles of the indirect kind; but in these cases the accidents are mostly accompanied by extensive lesions of the neighboring structures. Wounds of the spine from heavy direct projectiles, such as cannon-shot, being almost without exception immediately fatal, are not distinguished in the surgical returns; they only appear in the general list of killed in action.

In the Surgical History of the Crimean Campaign, thirty-two cases are noted in which vertebræ were fractured, ten being without apparent lesion of the spinal cord, and twenty-two with evident lesion. Of these twenty-eight died; and four, in which the fractures were confined to the processes of the vertebræ, survived to be invalided. Dr. Chenu's returns show that out of 194 fractures of bones of the vertebral column in the French army caused by bullets or shell, 181 men died, 11 survived to be pensioned, and 2 returned to duty. In the two latter instances the sacrum had been fractured. Six men only, who had been wounded in the vertebral column during the Sepoy mutiny in India, arrived at Chatham. In all, the wounds were the results of musket-balls. Two were wounds of the sacrum; in the remainder, the portions of the vertebræ fractured were the spinous processes. In the Circular issued in 1865 from the Surgeon-General's office at Washington, it is stated that of 187 recorded cases of gunshot fracture of the vertebræ, all but seven proved fatal. Six of these were fractures of the spinous or transverse processes; the seventh was one in which a musket-ball fractured the spinous process of the fourth lumbar vertebra, and penetrated the canal, but was extracted with the fragments of bone. In one fatal case in the Crimea, the ball passed through the spine rather below the first dorsal vertebra, leading to complete loss of sensation and voluntary motion below the seat of injury, and death on the sixteenth day afterwards; in another, the rifle-bullet entered the right side of the second lumbar vertebra, traversed the spinal canal at that part, and lodged in the body of the bone. In this latter case, violent pain was complained of in the lower extremities, shooting along the groins. The patient was paraplegic, and death ensued thirty-three hours after admission. In another fatal case, a rifle-bullet passed through the right cheek, and lodged near the base of the skull. There was no paralysis, but delirium and coma supervened, and the patient died five days after receiving the wound. The bullet was found after death, lying just below the basilar process, and a large piece of the atlas was broken off and almost detached. The spinal cord did not appear to have been primarily injured; but acute inflammation had been set up, and had extended to the membranes of the brain. There is a preparation in the Museum at Fort Pitt, which shows a gunshot fracture both of the atlas and axis, without lodgment of the ball. The patient survived thirty days. It is curious that, in a case which was under the care of the writer in the Crimea, where a rifle-ball passed through the right loin, entered the spinal canal between the third and fourth lumbar vertebræ, breaking the laminæ, passed upwards within the column, between it and the cord, and made its exit through the left intervertebral foramen between the second and third vertebræ, as shown after death four years afterwards; no paralysis occurred at the time of the injury, nor subsequently, nor was any evidence afforded at the post-mortem inspection of thecal inflammation having been excited (see Guy's Hospital Reports, vol. v., 1859).

[The following table is taken from the Surgical History of the War of the Rebellion, vol. i., p. 452:—

Table of the Results of Six Hundred and Forty-two Cases of Gunshot Injuries of the Vertebræ.

Region.	Cases.	Died.	Discharged	Duty.	Unknown.	Percent.of mortality.
Cervical	91	63	19	8	1	70.0
Dorsal	137	87	32	18	...	63.5
Lumbar	149	66	51	28	4	45.5
Cervical and dorsal	2	1	1	...	...	50.
Dorsal and lumbar	3	3	...	...	...	100.
Vertebræ not stated	260	129	72	50	9	51.4
Aggregate	642	349	175	104	14	55.5

This table does not embrace the cases which were immediately fatal, but those only which came under treatment. Of these more than half died. Cases of contusion and concussion are not included in this list. Nearly all of the recoveries were injuries of the transverse or spinous processes. After fracture of the body of the vertebræ, a few survived for some days. Paralysis is reported in only 151 of the 642 cases. Several reports are made of fracture of the lumbar vertebræ with injury of the cord, without paralysis. Many of the cases were complicated with wounds of the thorax and abdomen. Tetanus ensued in seven cases. Pyæmia in eight. Dyspnœa in some of the cases of injury of the cervical and dorsal vertebræ; dysphagia in a number of instances; constipation, as a rule, in the early stages; afterwards paralysis of sphincter and involuntary fecal discharges. Retention and overflow of urine was common. Priapism is noted in three cases, all injuries of the cervical vertebræ.

Dr. Otis says the reports of these cases are generally brief, and rational symptoms evidently not always noted.

The writer recalls two instances of priapism supervening on fracture, in one case of the middle and in the other of the lower dorsal region, with lesion of the cord in both cases. The two men were injured, with many others, by the giving way of the floor of a room in the Virginia State Capitol building. Both died; also three cases of priapism following gunshot injury of the dorsal and lumbar vertebræ, in one of which he made an unsuccessful attempt to save life by trephining.]

In injuries of the vertebral column and spinal cord occurring in military practice, the mischief is usually so complicated and extensive, and the medulla itself so bruised, that the cases must be very rare indeed in which the operation of trephining, if justifiable in any case, can offer the slightest prospect of benefit. M. Baudens extracted, by means of an elevator, a ball which had lodged in the eleventh dorsal vertebra, and was causing compression with complete paraplegia. The paralysis disappeared immediately after the extraction of the bullet; but tetanus came on four days afterwards, and proved speedily fatal.

[*Table of the Results of Sixty-two Operations after Gunshot Fractures of the Vertebræ.*

Operation.	Region.	Cases.	Died.	Discharged.	Duty.	Unknown.
Ball removed	Cervical	1	1	...	...	
" "	Dorsal	12	4	7	1	
" "	Lumbar	16	5	7	3	1
" "	Not stated	5	3	1	...	1
Bone "	Cervical	5	2	2	1	
" "	Dorsal	6	2	1	3	
" "	Lumbar	9	4	4	1	
" "	Not stated	4	2	...	2	
Ligations	......	4	4	...	...	
Total	......	62	27	22	11	2

Seventeen of the 642 cases in the first table, on p. 582, were complicated with hemorrhage, fourteen died.

No instance of formal trephining is reported. The operations were chiefly for the extraction of balls and fractured fragments of bone. It will be seen in the second table that only ten deaths occurred in twenty-four cases of the removal of fragments of the vertebræ after gunshot fracture. In nine of these cases parts of the spinous processes alone were taken away, and many of the injuries were manifestly slight. When the laminæ or transverse processes were broken and removed, the cases were more serious, and the five cases of reported recoveries were left with permanent disabilities.

The propriety of trephining the spine after gunshot fracture has been discussed since the time of Paré, and the operation repeatedly performed. It has ended fatally almost invariably—indeed it is doubtful if there is on record one completely successful case.]

Gunshot Wounds of the Face.

Wounds of the face from musket-shot, grape, and small fragments of shell are usually more distressing from the deformity they occasion than dangerous to life. Out of 573 cases of face-wounds registered in the Crimea among the British troops, only 14 died. No fatal case occurred among the officers. The proportion in the French army was larger. Dr. Chenu's returns show that out of 1747 wounds involving the face and eyes, from gunshot, 287 died. [In the statistics of the Italian war of 1859, M. Chenu records 955 cases of injuries of the face, with 114 deaths, or a mortality of 11.9 per cent.] The Washington Circular before mentioned states that of 4167 gunshot wounds of the face, there were 1579 fractures of the facial bones, and 2588 flesh wounds; and that of the former, 891 recovered, 107 died, while the terminations of 581 cases were still to be ascertained.

[In the following table, taken from the Surgical History of the War of the Rebellion, part I., p. 382, the statistics of 9815 wounds of the face from all causes are given. The terminations of 1580 of these cases could not be traced. In the remaining 8235, where the result was known, the ratio of mortality was 5.7.]

Table of the Nature and Results of Nine Thousand Eight Hundred and Fifteen Injuries of the Face from all Causes.

Injuries.	Cases.	Duty.	Discharged.	Died.	Unknown.
Sabre and bayonet wounds	64	40	15	2	7
Fractures of the bones of the face from various causes	64	37	17	3	7
Injuries of the face from miscellaneous causes	271	167	83	3	18
Gunshot flesh-wounds of the face . .	4914	2396	1310	58	1150
Gunshot wounds of the orbital region .	1190	379	679	64	68
Gunshot fractures of the bones of the face	3312	1154	1488	340	330
Aggregates	9815	4173	3592	470	1580

The absence of vital organs; the numerous natural divisions among the bones, and their comparatively soft structure, causing them to be less liable to extensive splitting; the copious vascular reticulation and supply rendering necrosis so much less likely, and repair so much easier than in other bones; the limited amount of space occupied by the osseous structures between their respective periosteal investments; and the opportunities from the number of cavities and passages connected with this region for the escape of discharges; are all causes of the comparatively favorable results of wounds in this as regards wounds in other regions. On the other hand, the vascularity of this region leads to danger both of primary, and especially secondary, hemorrhage,—a circumstance which in all deep wounds of the face must be looked for as a not improbable complication. Lodgments of projectiles in some of the cavities of this region are not unfrequent accidents. The other complications of these gunshot wounds are lesions of the organs of special sense; of parts concerned in mastication, deglutition, and articulation; injury to the base of the skull; paralysis from injury to nerves; wounds of glands or their ducts, or of the lacrymal apparatus; but it is scarcely necessary to do more than allude to these lesions, as the considerations connected with their treatment will be found elsewhere.

Wounds from cannon-shot occasionally illustrate what horrible and extensive injuries may be borne in this region without life being at once extinguished. They are the more distressing because the patient lives conscious of his sufferings without possibility of surgical alleviation. The case of an officer of Zouaves, wounded in the Crimea, is recorded, who had his whole face and lower jaw carried away by a ball, the eyes and tongue included, so that there remained only the cranium, supported by the spine and neck. This unfortunate being lived twenty-four hours after the injury, breathing by the laryngeal opening at the pharynx, while his gestures left no doubt that he was conscious of his condition. Mr. Guthrie has recorded a similar case which occurred in an officer during the assault of Badajos. This patient suffered distressingly from want of water to moisten his throat, but could not swallow when some was brought. One eye was left hanging in the orbit, the floor of which was destroyed, and this enabled him to write thanks for attention paid him. He did not die till the second night after the injury.

In the treatment of gunshot wounds of the face where the bones are much separated and displaced, the surgeon should always retain and readjust as many of the broken portions as possible. It is often surprising how small connections with neighboring soft parts will suffice to maintain vitality, and lead to restored union in this region. A case which occurred to the writer in August, 1855, in a private of the 19th Regiment, is detailed in the Lancet, p. 436, of that year. The wound was caused by a fragment of shell. The right half of the arch of the palate was jammed in and fixed at right angles to the other half, and the upper maxillary bone was so shattered that it was scarcely possible to note the directions of the lines of fracture. The lower maxilla was broken in three places, and there was extensive laceration of the soft parts. Great difficulty was met with at first in unlocking the parts of the palate which had been driven into each other, and, when they were separated, the right half hung down loosely in the mouth; yet favorable union was obtained between all these fractures, the broken portions being adjusted so that the man recovered with both the upper and lower maxillæ consolidated in their normal relations to each other. No teeth had been driven out of their sockets, and they were very useful as points of support in the steps taken to procure coaptation of the disunited fragments.

[In the Federal and Confederate armies, in the late war between the States, the treatment of wounds of the face was generally as follows: The wound was cleansed; completely detached pieces of bone removed; hemorrhage arrested by ligature, or torsion, or by cold, or by compress and bandage; fragments of bone not detached but displaced, and soft parts torn and distorted, pressed as nearly as possible into proper position, and retained by sutures, adhesive plaster, compress and bandage. The dressing was kept wet with cold water, or some simple medicated lotion. No bone or soft part was removed when its vitality could be preserved. Paring or refreshing the contused edges of gunshot wounds of the face, and then uniting by sutures, recommended by Larrey and Desault, was in a few instances tried by Confederate surgeons, with doubtful results. (See Michell, Confederate States Medical and Surgical Journal.)

When salivation was profuse, or the discharge from the mouth offensive, it added to the comfort and health of the patient to syringe or mop out the mouth frequently, with some detergent lotion. When the pain was great opium was given. The bowels were kept open with saline cathartics, and for the first three or four days an antiphlogistic regimen pursued.

Secondary hemorrhage, after gunshot wounds of the face, is of frequent occurrence. Primary hemorrhage, unless some large vessel is wounded, is generally arrested by position, cold applications, or pressure. Powders and solutions of the persulphate and perchloride of iron are worse than useless to control bleeding in such injuries. They are dirty, painful, corrosive, and conceal the relative position of the parts. Applications of hot water will often arrest hemorrhage when cold water fails. When secondary hemorrhage occurs, the bleeding vessel should be found, if possible, and secured by ligature: if this is impracticable, and a tampon, or compress and bandage fail to control it, the only recourse is to tie the carotid.

In table XV., p. 394, Surgical History of the War of the Rebellion, 55 cases of ligature of the common carotid for gunshot wounds of the face, are tabulated. In 2 of these cases the external carotid was also tied.

The results are known in 54 of the 55 cases; 15 of the patients recovered and 39 died, a mortality of 72.2 per cent. Two of the 55 ligations were for wounds of the soft parts. The others involved fractures chiefly of the upper and lower jaw-bones. The average period of the date of operation, after the date of injury, was 18 days. The average period of the date of death after date of operation, in 38 cases, was six days. In 4 cases, the common carotid was re-ligated, one recovered. Six cases are reported of ligation of the external carotid alone; four recovered.]

GUNSHOT WOUNDS OF THE NECK.

Gunshot wounds of this region do not appear to be so fatal as might be anticipated from the large vessels and important canals leading to the thorax and abdomen, which at first sight appear to be so exposed and unprotected. Out of 147 cases of gunshot wounds of the neck admitted into the English hospitals in the Crimea, there were only 6 deaths—a mortality of 4.08 per cent. The mortality in the French army was much greater. Dr. Chenu's returns show that out of 385 patients with gunshot wounds in the neck in the French ambulances, 101 died,—a mortality of 26.2 per cent. It is difficult to explain such a different result. The Circular from the Surgeon-General's Office at Washington, states that of 1329 cases of gunshot wounds of the neck entered on the records, the ultimate results of 546 only had been ascertained, and that in these the mortality was 14 per cent. In no region are so many examples offered of large vessels meeting, but escaping from balls in their passage, as in this; because the cause which operates elsewhere—ready mobility among long and yielding structures—exists in a greater degree in the neck than in any other part. Where the large vessels happen to be divided, death must follow almost immediately.

Superficial wounds of the neck offer no peculiarities. The larynx and trachea being the organs most prominent, and most frequently injured, are those which chiefly attract the surgeon's notice in warfare; but a consideration of the anatomical structure will at once show what numerous other complications, whether from direct injury or consequent inflammation, projectiles are likely to cause when they are driven deeply into, or perforate this region.

A brief abstract of some wounds of the neck, which occurred during the Crimean campaign, will serve to exhibit the leading symptoms connected with them when the larynx, or larynx and œsophagus are involved.

In the surgical history of the war, it is stated that only three wounds of the neck, other than simple flesh-wounds, occurred among the officers from the commencement to the end of the war; of which two proved fatal, and one led to invaliding. In that number, however, is not included the case of an officer, Lieut. M., of the 19th Regiment, who came under the care of the writer. In this instance the neck was completely traversed, the œsophagus perforated from side to side and the larynx injured. After the shock had subsided, the leading symptoms were aphonia, dysphagia, numbness of one arm, œdema and stiffness of the neck, distressing accumulation of mucus about the fauces, and slight pyrexia. Recovery progressed favorably, and on the twenty-second day after the injury both external wounds in the neck were healed, and the two in the œsophagus appeared to be closed also. The patient referred to still suffers from a certain amount of aphonia. It was not enough to prevent him from performing his duties as a captain, but the want of sufficient power of voice disabled him for a more extensive command, and ultimately caused him to leave the army. Another of these cases, in which emphysema of the neck, œdema of the glottis, great dyspnœa, and threatened suffocation gradually supervened in a superficial gunshot wound of the neck with fracture of the thyroid cartilage, was treated by Assistant-Surgeon Cowan, 55th Regiment, who performed tracheotomy, and thereby saved the patient's life. In another the ball passed through the thyro-hyoid membrane, fractured the thyroid cartilage, and tore the lining membrane of the glottis. Tracheotomy was performed on the day after the injury without benefit, and the patient died. Liquids could not be prevented from passing into the trachea through the wound made by the projectile. In the case of a private of the 97th Regiment, a bullet entered at the pomum Adami, and passed out by the anterior edge of the right sterno-mastoid muscle. Loss of voice, frequent cough, bloody sputa, slight emphysema at the wound of entrance, and nausea were the leading symptoms. When the man attempted to drink, some of the fluid escaped by the wound of exit. After five days this occurrence ceased; and after the twelfth day, air no longer passed out of the wound of entrance. Both wounds gradually healed; but aphonia—the voice being reduced to a whisper—existed when the man left the regimental hospital. A soldier of the Rifle Brigade, under the care of Deputy Inspector-General Fraser, C. B., then surgeon of the battalion, had been shot through the trachea, and respiration was for some time carried on by the wound; gradually, however, it completely healed, and a favorable recovery ensued. Another interesting case occurred in a soldier of the same battalion, at the last assault of the Redan. A rifle-ball entered the man's neck at the lower part of the left sterno-mastoid muscle, passed across under the skin, wounding the anterior surface of the trachea, severed some fibres of the right sterno-mastoid, and effected its exit. The man was wounded at the same time by two other rifle-balls, both flesh-wounds, one through the left forearm, the other through the upper part of the right thigh; while a shell exploding near him, caused his left eye to be penetrated with particles stone and earth. Vision was lost; in other respects, excepting a little eness from the wound in the thigh, he s discharged cured, after fifty-six days' spital treatment.

The liability to concussion of the cervi- l portion of the vertebral column, and injury of the deep cervical and other erves, must not be overlooked. Wounds f the neck are often accompanied by more or less loss of power in one of the upper extremities; and more extensive paralysis occasionally succeeds, although there was no primary evidence of the spine being implicated in the injury.

[The table below, taken from the Surgical History of the War of the Rebellion, Part I., vol. ii., p. 414, is a consolidated report of 4895 cases of gunshot wounds of the neck without known injury to the cervical vertebræ, and shows the heavy death-rate of 15 per cent. This is explained by the statement that the figures were collected from regimental field and hospital reports, and do not embrace many cases which never came under treatment.

Table of 4895 Cases of Gunshot Wounds of the Neck with known injury to the Cervical Vertebræ.

Character of wound.	Cases.	Died.	Discharged.	Duty.	Unknown.
Gunshot wounds of the neck	4789	570	1056	2394	769
Gunshot wounds of the neck, injuring trachea .	41	21	11	8	1
Gunshot wounds of the neck, injuring larynx .	30	10	8	2	10
Gunshot wounds of the neck, injuring pharynx .	13	7	2	3	1
Gunshot wounds of the neck, injuring œsophagus	10	6	2	2	
Gunshot wounds of the neck, injuring trachea and larynx	4	...	1	3	
Gunshot wounds of the neck, injuring trachea and pharynx	2	...	2		
Gunshot wounds of the neck, injuring trachea and œsophagus	2	2			
Gunshot wounds of the neck, injuring larynx and œsophagus	1	...	1		
Gunshot wounds of the neck, injuring pharynx and œsophagus	1	...	...	1	
Gunshot wounds of the neck, injuring pharynx and larynx	2	2			
Aggregate	4895	618	1083	2413	781

The comparatively small number of cases of injury of the windpipe and œsophagus, 106 cases in 4895, cannot be accounted for by the curious way in which these structures are known sometimes to elude missiles. The disproportion is probably due to the fact that many of the cases were at once fatal, and wounds of these organs were not recorded in the reports. Missiles lodged in the neck in 136 cases; in 87 they were extracted; in some cases they became encysted; in a few instances they gravitated to the nearest cavity, or to some external surface. Permanent wryneck was found in many cases, where the muscles alone were injured. This statement does not agree with the assertion of Stromeyer, that gunshot wounds of the neck, involving the muscles alone, are not followed by permanent torticollis. More or less aphonia followed gunshot wounds of the neck in some cases, and Chisholm reports several instances in the Confederate army, where tracheal tubes were permanently worn to prevent apnœa after injuries of the larynx and trachea. The writer recalls two cases of gunshot wounds of the upper part of the larynx, followed by aphonia and by loss of sensibility of the glottis, a condition to which Mr. Erichsen especially has directed attention. Failing to contract, the glottis permitted the passage of food and drink into the larynx during the act of swallowing, bringing about violent coughing and choking.

Many cases of paralyses of the arm, face, tongue, glottis, and other parts, complete or partial, are recorded by Dr. Otis. In some of the cases the nerves were cut by the missile; in others the paralyses were due to inflammatory changes following the injury, and two cases are reported to be due to contact of the balls with the nerve, as was shown by the complete recoveries in both instances, after the balls were extracted.

Sloughing and gangrene were seldom witnessed in the cases reported of gunshot wounds of the neck. Pyæmia was not a common sequel; erysipelas was often observed, but was rarely fatal.

Secondary hemorrhage very often occurred, and was the most fatal of all complications; in these cases, where compression can be employed and fails to arrest the hemorrhage, the wound should be enlarged, and no matter how difficult the dissection, the bleeding vessel should be found and *both* ends secured by ligature. Tying the common carotid in such cases is rarely successful. In 29 cases reported by Dr. Otis, 22 died, and in one case the result is unknown.

If to these cases we add the 55 cases of ligature of the common carotid in gunshot wounds of the face, we find 84 ligatures of the common carotid for gunshot wounds of the face and neck, with 61 deaths.]

GUNSHOT WOUNDS OF THE CHEST.

These always form a large proportion of the injuries from warfare, both in the open field, and more especially in sieges, where the upper part of the body is chiefly exposed. Dr. Scrive's returns show that the proportion of chest to other wounds was 1 in 12 in the trenches, and 1 in 20 in ordinary engagements. In the British forces they are returned as 1 in 10 among the officers during the whole war, and nearly 1 in 17 among the men, from April 1, 1855, to the end of the war. The ample space occupied by the chest and the exposed surface it presents as a target towards the enemy, would lead to the anticipation that wounds of this region would be very numerous in warfare. The grave accidents which are not unlikely to follow the severer forms of superficial gunshot injuries of the chest, although the pleural cavities may remain unopened; the serious complications which are induced when the cavity of the chest is penetrated; together with the dangerous consequences of wounds of its chief viscera — the heart, great vessels, and lungs—cause the proportionate mortality to be very great. The British returns show that among the officers who came under hospital treatment for chest-wounds of all kinds, wounds of the chest-walls, as well as of the cavity enclosed by them, 31½ per cent., and among the men 28$\frac{1}{16}$ per cent., died. Dr. Chenu's returns show that in the French army, out of 2506 chest-wounds, penetrating and non-penetrating, there were 817 deaths, or 32.6 per cent. Out of 935 survivors among soldiers of the Royal army wounded in the Sepoy mutiny of 1857-58, who were invalided home to England, the number invalided from the effects of wounds of the chest, all kinds included, was only 36. In many instances soldiers wounded in this region do not live long enough to come under surgical treatment, but die on the field of action either from penetration of the heart, hemorrhage, suffocation, or shock; and the proportion of men with fatal chest-wounds returned as "killed in action," or as "died under treatment," will constantly vary according to circumstances connected with the nature of the military operations, and the opportunities of early removal from the field to the field-hospitals.

Gunshot wounds of the chest may conveniently be divided for study into two classes, viz., *non-penetrating* and *penetrating*. NON-PENETRATING wounds become subdivided into simple contused wounds of the soft parietes; contused and lacerated wounds; similar wounds accompanied with injury to bones or cartilage; and lastly, those complicated with lesion of some of the contents of the chest, the pleura remaining unopened, or, if the pleura be opened, without any superficial wound of the integuments. In none of these—and this is their important distinction—is there any communication between the air external to the parietes, and the serous cavities of the chest. PENETRATING wounds may exist without wound, or with wounds, of one or more of the viscera of this cavity. Among the more serious complications with which the latter may be accompanied, is the lodgment of the projectile or other foreign bodies, or of fragments of bone, within the chest. As wounds of the heart and great vessels are almost invariably at once fatal, and as the organs of respiration occupy the greater part of the cavity of this region, it is with reference to the latter that the treatment of chest-wounds is chiefly concerned.

Non-penetrating wounds.—This division of gunshot wounds includes a considerable proportion of recoveries. Out of 327 non-penetrating wounds and contusions of the chest, in the English army in the Crimea, there were only 15 deaths; out of 1509 wounds of the same kind, in the French army, according to Dr. Chenu's returns, there were 184 deaths. The Washington Circular, before quoted, refers to 4759 flesh-wounds of the chest, and states in a general way that they presented a very small ratio of mortality. [11,549 cases are reported in the Surgical History of the War of the Rebellion, Part I., vol. ii., p. 472, of gunshot flesh-wounds of the parietes of the chest, not including the dorsal portion. The result was not ascertained in 658 cases, which were taken chiefly from incomplete Confederate records. In the 10,891 remaining cases 113 died, or about 1 per cent.]

Of the simpler wounds, in which the soft parietes only are involved, little need be observed, excepting that the healing process is often a long one, owing to the natural movements of the ribs to which the wounded structures are attached interrupting the process of repair, especially when the ball has taken a prolonged course beneath the skin, and also owing to the frequent supervention of pleuritis and its consequences. The surgeon must be on his guard to watch for pleuritis arising as a consequence of these injuries, however trivial the wound or contusion produced by the projectile may at first appear. Two deaths are recorded in the British History of the Crimean War, under simple flesh-wounds and contusions, without fracture or pleural opening, from bullets; and in both of these the fatal termination arose from pleuropneumonia.

When the force with which the wall of the chest has been struck has been great, as when a heavy fragment of shell strikes at full speed against a man's breast-plate, the injury is not only liable to be followed by severe ecchymosis, but the subsequent effects of the contusion frequently show themselves in abscesses, necrosis of ribs, and sinuses of a troublesome character lasting for years afterwards. The cartilaginous, or even the bony, parietes, may be momentarily forced inwards at the time of such an injury, so that the lungs become compressed and bruised, though not opened. In such a case blood may be expectorated by the mouth in considerable quantity, and, even if no such hemorrhage as this takes place, hæmoptysis will almost invariably be one of the symptoms presented. Ecchymosis, or, at least, congestion of the lung itself to a partial extent, in all probability follows every non-penetrating gunshot wound of the chest of much severity. Instances occasionally occur, among injuries of the chest from projectiles of large size, in which, notwithstanding no open wound of the parietes nor fracture has been caused, and no opening of the lung effected, yet death follows with all the symptoms of suffocation, apparently due to the direct result of contusion of the pulmonary structure and its consequent engorgement.

Lastly, with regard to these non-penetrating wounds, we may occasionally expect to meet with a solution of continuity in some viscus of the thorax, more especially of a lung, without any direct communication between an external opening and the wounded organ; and the injury may be accompanied or unaccompanied by a wound of the costal pleura. These occurrences are sometimes due to the chest-wall being forced inwards in such a way as not only to compress, but also to lacerate, a lung between the opposite walls, without fracture of bone; sometimes to a rib or ribs being broken, and the lung being wounded and penetrated by sharp points of fractured bone, in the same way as not unfrequently happens in the accidents met with in civil life. In warfare these lesions are generally the result of injuries from large projectiles of irregular form, such as fragments of shell.

Penetrating wounds.—When we examine statistically the results of penetrating wounds of the chest in warfare, we find that the mortality denoted is very large. Out of 22 officers so wounded in the Crimea, 15 died; and out of 125 men, 105 died, showing, when taken together, a mortality of 81.6 per cent. Dr. Chenu's Crimean returns show that out of 508 patients with penetrating wounds of the chest in the French army, 467 died, a mortality of 91.9 per cent. The percentages are here greatly increased by the proximity of the field-hospitals in the Crimea to the trenches in which most of the patients were wounded; had they been wounded under the ordinary circumstances of battle, they would never have reached a hospital, and would have been included in the number of dead on the field itself. The American returns are not yet complete. The records hitherto published state that 2303 cases had been transcribed, in which either the thoracic cavity had been penetrated, or the injuries had been accompanied by lesions of the thoracic viscera. The results had been ascertained in 1272 of these cases, and were fatal in 930, or in 73 per cent. Cases of non-penetrating wounds, in which lungs had been pierced by broken ribs, and those in which the lungs had been only contused, are mingled in the American returns with the penetrating wounds; this prevents exact comparison with the results shown in the English and French Crimean returns.

[The Surgeon-General's office at Washington reports 8404 cases of gunshot penetrating wounds of the chest; of these 5260 died, giving a death-rate of 62.5.

Dr. Otis believes, with other writers on military surgery, that many cases reported as recoveries after penetrating wounds of the chest, were, in truth, cases of non-penetrating wounds, and that if all the diagnoses could be carefully scrutinized, and final results traced, the proportion of deaths would be found heavier than reported. It is interesting, however, to compare the result published by the Surgeon-General's office, with that of others, which Dr. Otis has collected in the following table :—

Action.	Wounds.	Died.	Mortality rate.
New Zealand (Mouat)	23	15	60.8
French in the Crimea (Chenu)	491	450	91.6
British in the Crimea (Matthew)	164	130	79.2
French in Italy (Chenu)	256	119	46.48
Austrians and Italians (Demme)	159	97	61.
Hanoverians in Schleswig-Holstein (Stromeyer)	97	17	17.6
Prussians in Danish War, 1864 (Loeffler)	137	57	41.6
Danes in Danish War, 1864 (Loeffler)	113	76	67.2
Prussians in Six Weeks' War (Maas)	12	4	33.3
Prussians at Langensalza (Stromeyer)	47	31	65.9
Prussians at Landshut (Biefel)	15	8	53.3
Germans in Franco-Prussian War (Billroth)	30	9	30.
Germans near Metz (Fischer)	34	19	55.8
French at Sedan (MacCormac)	31	17	54.8
Total	1609	1049	65.2]

Fatal consequences ensue in penetrating wounds of the lungs, either from primary hemorrhage, leading to exhaustion or suffocation; from active inflammation of the pleuræ and pulmonary structure; from irritative fever accompanying profuse discharges; from fluid accumulations in one or both of the pleural sacs; from extension of inflammation to the pericardium; or from circumstances inducing secondary hemorrhage.

In gunshot injuries a penetrating wound of the chest is in most instances readily obvious to the sense of sight or touch. The end of the finger can be inserted, and there can be no mistake about the nature of the injury. But occasionally, notwithstanding an opening has actually been made into the chest, difficulties and mistakes in the diagnosis occur; particularly if the bullet has passed through the scapula, shoulder, or from any more distant part; if it be small, like a pistol-ball, and has entered very obliquely; or if, from accidental position of the patient, the particular part of the integument which was pierced at the time the opening was made in the chest-wall has glided away, and so left the track of the bullet covered by sound skin. Again, even when we have clear evidence that the cavity of the chest has been opened, it will be found by no means easy always to decide whether a lung has been penetrated or otherwise. The train of symptoms usually described as characterizing *Wounds of the Lung* must not be expected to be all constantly present; they are each liable to be modified by a great variety of circumstances, and may each severally exist in penetrating wounds of the chest where the *lung* has escaped from being opened. It is only by a combination of symptoms, rather than by the presence of any one or other symptom, that a lung-wound can in many instances be diagnosed. Nor is it always easy to determine whether the ball has lodged or not; or, when the ball has passed through, whether fragments of bone, or other substances, have remained behind.

When the cavity of the chest has been opened by a projectile, and the lung wounded, the following circumstances may be looked for, in addition to those physical evidences of the injury which are obvious to sight and touch: a certain amount of constitutional shock; collapse, and tendency to syncope from loss of blood; hemorrhage from the external wound; effusion of blood into the pleural cavity; hæmoptysis; and dyspnœa. If these symptoms are all present we may conclude that a lung has been wounded; but we must not conclude that a lung has not been wounded because any one or more of them are absent. Escape of air by the external wound, and emphysema, are also named by some surgeons as characteristic signs of a lung-wound. The primary symptoms will generally, but not invariably, be followed, after twenty-four hours or later, by the usual signs of inflammation of some of the structures injured. It is not possible within the limits of this article to discuss the import of these several symptoms as regards gunshot wounds, but some of them may be briefly referred to.

The shock of a penetrating wound of the chest, apart from the collapse consequent on hemorrhage, is not generally so marked a symptom as it is in extensive fractures of the larger bones of the extremities or in penetrating wounds of the abdomen. There is often much more "shock" when a ball has not penetrated; when it has met something to oppose its course, as part of a soldier's accoutrements, and when, although it has not entered, it has nevertheless struck with such force as to cause a violent concussion of the whole chest and its contents.

Sudden copious *hemorrhage* coughed

into the mouth, and rapidly recurring, after a projectile has entered the chest, sufficiently indicates that a lung has been penetrated. But moderate expectoration of blood or ordinary *hæmoptysis*, although it indicates injury of some sort to the lung, by no means gives assurance that this organ has been opened. Hæmoptysis generally accompanies gunshot wounds of the lung in a greater or less degree, no doubt always when a bronchial tube of any large size is penetrated and the lung remains pervious; but it is sometimes wholly absent, even though a lung has been extensively opened, and although the patient is troubled by cough. Dr. Fraser, in a monograph on Wounds of the Chest, has stated that out of nine fatal cases observed by him in the Crimea in which the lungs were wounded, only one had had hæmoptysis; and out of seven fatal cases in which the lungs were not wounded, two had had hæmoptysis. This, however, from the writer's observations, would appear to be an unusual proportion of cases in which hæmoptysis was not present after lung-wounds.

Hemorrhage *outwards* from the opening of a chest-wound does not as a general rule occur to an extent to excite the surgeon's anxiety as compared with other symptoms. Now and then, after a severe wound, when blood escapes into the pleural cavity, and the opening in the chest-wall is large and free, it will flow copiously from the external wound; and, if both the opening in the lung, as well as that in the chest-wall remains free, we shall find the blood mixed with air, and jetting out whenever the patient coughs. Or the hemorrhage may proceed in a more direct manner from the pulmonary structure, the escape outwards being due to the effect of old close adhesions connecting the lung with the costal parietes and so making the external opening continuous with the track of the wound. More usually, however, external bleeding, when it occurs, is due to lesion of an intercostal, perhaps also of branches of the internal mammary artery, in consequence of these vessels having been torn by the sharp ends of fractured ribs.

Primary *internal* hemorrhage is always an alarming symptom. It is the chief source of death in those cases of lung-wounds which prove mortal from the early effects of the injuries inflicted; the fatal event being sometimes induced by it rapidly after the receipt of the wound, sometimes not until two or three days have elapsed. There are no means by which the exact position of the sources of internal hemorrhage can be determined. If immediately after a gunshot wound, copious hemorrhage by the mouth, and fatal syncope or suffocation quickly supervene, the inference is obvious that the projectile has opened some of the large pulmonary vessels. But when the internal hemorrhage proceeds more slowly, it may either be derived from divided pulmonary vessels, or from some of the parietal arteries, or from both sources combined. When the blood continues to flow into the pleural sac—as indicated by the persistent blanched appearance of the patient, the cold clammy surface, increasing dyspnœa, occasional hæmoptysis, and the stethoscopic signs on auscultation—and when no traces of a source of hemorrhage in the parietal wounds can be discovered, there can remain little doubt that it is from the structure of the lung itself that the blood is flowing. The amount of hemorrhage in wounds of the lungs varies greatly according to the direction of the track of the ball; for the large vessels cannot here glide away from the action of the projectile, as they may in the neck or extremities of the body. The situation of the wound of entrance, or, if it be a perforating wound, the course the ball has taken, inferred from the relative positions of the wounds of entrance and exit, will therefore greatly help us to determine the probable site of the bleeding, and, to some extent its probable degree of gravity. Wounds near the root of each lung, where the pulmonary arteries and veins are largest, are attended with the greatest amount of hemorrhage; and, as coagula can hardly form sufficiently to suppress the flow of blood, are generally fatal.

Dyspnœa is a frequent accompaniment of wounds penetrating the lung, but, again, is not an invariable symptom. When dyspnœa is greatly complained of in the early period, and is not accompanied with signs of internal hemorrhage and pressure, it will sometimes be found to depend upon the injuries to the parietes, and to the pain caused on taking a full inspiration, or to congestion of the lung from the concussion to which it has been subjected. When a lung has been penetrated, and dyspnœa is an urgent symptom before sufficient time has elapsed for inflammatory action to have been induced, the dyspnœa may be caused by pressure upon the lung, either from effusion of blood, or from accumulation of air in the pleural sac. Examination by percussion and the stethoscope will decide the existence of either of these two sources of compression. The dyspnœa, if great, indicates that the power of expansion of both lungs is interfered with by pressure; when the compression is limited to one lung, though it may be completely collapsed in consequence, especially if the opening in the chest-wall be a large one, the symptom of dyspnœa may be wholly absent. It will be readily understood how much the situation of the wound; its direction, whether communicating immediately or by a sinuous course with the pleural sac; the size of the opening; and other circumstances, must modify the occurrence of this symptom.

It is sometimes stated that the escape of air by a chest-wound is a sufficient proof that the lung has been opened by the projectile. Experience has shown that by itself this occurrence is not a sufficient proof of a lung-wound. Air has been noticed to escape, when it has been afterwards proved that the lung was not wounded; and no air may escape though the lung is wounded. In the former case, the air may have entered by the wound, and have been forced out again by the expansion of the lung in inspiration, or by the sinking of the chest on expiration; in the latter case, a variety of conditions, both as regards the wounded lung itself and also the chest-walls, may prevent the occurrence of this symptom. If air and frothy mucus with blood, as noticed in some cases, escape by the wound, there can be no doubt of the nature of the injury. Emphysema of a diffused kind is, again, not often seen in penetrating gunshot wounds, though it occasionally happens. The free opening generally made by the projectile sufficiently explains this fact.

The limits of this essay prevent reference at any length to the inflammations which supervene on these wounds. Diffused inflammation of the lung itself is not so common as might perhaps be expected. In unfavorable cases, the pleural cavity is generally found to be the seat of extensive inflammatory action, with unhealthy accumulations of sero-purulent fluid, floating lymph, and broken-up clot, especially where irritation has been kept up by the presence of foreign bodies, or the patient's constitution has become debilitated from any cause.

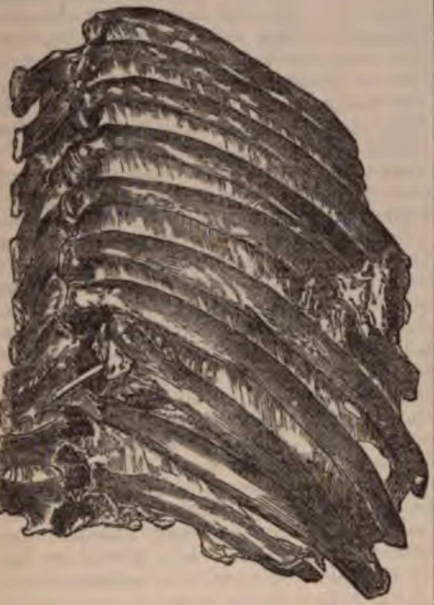
Natural process of cure of lung-wounds.—When a case of bullet-wound of a lung progresses favorably, the following are usually the successive steps of the curative process. The pleura adjoining the seat of injury becomes inflamed, exudation occurs, and by this means the orifice of entrance in the lung, and of exit also, if the ball has perforated its structure, become adherent to the costal parietes shortly after the receipt of the injury. The openings made by the ball, both the opening in the chest-wall and that in the lung, thus become circumscribed and excluded from the general pleural cavity. In a similar way, the track of the projectile through the lung is shut off from communication with the rest of the organ by effusion into the parenchyma around it. If, however, any bronchial tubes of rather large size have been opened in the course the bullet has taken, these do not close; and, in consequence, a communication is kept up between the wound and the principal air-passages. In a few days suppuration becomes established along the track of the ball through the lung, the matter being principally discharged by the external openings of entrance and exit; the contused surface of the wound along which the ball has passed sloughs and comes away in the discharges, and the fresh surface, which thus becomes exposed, is lined with a layer of lymph. The altered texture of the parts now reduces the wound to the condition of a fistula. This, as the cure proceeds, gradually contracts, the external wounds become cicatrized, and in this way a restoration of continuity is finally established.

Sometimes when the bullet has been a very small one, another process of cure occurs. There is not formed the intimate connection between the wound in the chest-wall and that in the lung, and there is not the escape of discharges and sloughs by the external parietal opening, but the lung-wound being diminished in size near the surface of the organ, by partial collapse of the lung substance and from becoming plugged by coagulum, is thus excluded from communication with the pleural cavity, and the purulent discharges which follow escape through the bronchi and mouth. The wound in the chest-wall becomes healed independently of the wound in the lung.

In some instances, when the subject of a bullet-wound of the lung has lived for many years, on examination after death, the track of the ball, though completely closed, has been readily perceptible on being cut across, from part of the lung around it being consolidated to a greater or less extent; in others, in which no doubt had been felt that the lung had been traversed, the healing, presuming the diagnosis to have been correct, has been so perfect that the direction in which the ball had passed could not be detected. When the ball itself has lodged and become embedded in the substance of the lung, it is generally found sacculated in a cyst so intimately connected with the lung-tissue that they can hardly be separated from each other by dissection. When balls have thus lodged with impunity in the pulmonic tissue, they have usually been found near the periphery of the organ, and the part of the lung in which they are embedded has become adherent to the costal parietes. Thus the weight of the projectile has been partly sustained, as it were, by suspension, and pressure upon the lung-substance proportionably obviated.

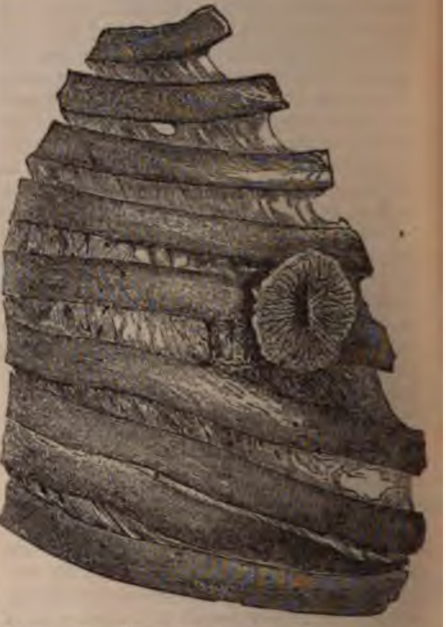
The first of the two healing processes of a gunshot wound of the lung described is well illustrated by figs. 762 to 764. They are taken from a preparation in the Army Medical Museum at Netley. The history of the case is briefly as follows. The patient, Private O. Doyle, a young soldier, was subjected to a perforating wound of the right side of the chest and lung by a musket-ball on November 26, 1857, in India. He returned to England in August. 1858, and on the 15th of October of the same year, eleven months after his wound, died of gangrene of the left, or unwounded, lung. The wound of entrance, which was between the sixth and seventh ribs, four inches from the outer side of the right nipple, was then soundly healed; the wound of exit, which was between the tenth and eleventh ribs, close to the spine, had been prevented from becoming completely closed by the lodgment towards the termination of the track of the ball of some small pieces of bone which had been torn away from the ribs in front by the bullet in its passage. The steps taken by nature to aid the curative process by arresting as far as possible the movements of the ribs at the respective seats of injury are worthy of observation.

Fig. 762.



Position of the wounds of entrance and exit in the case of Private O. Doyle. (See text.) The probe is inserted into a sinus connected with the wound of exit. The fragments of the broken rib are firmly united, much thickened, and by their position oppose movement of the ribs above and below the seat of injury.

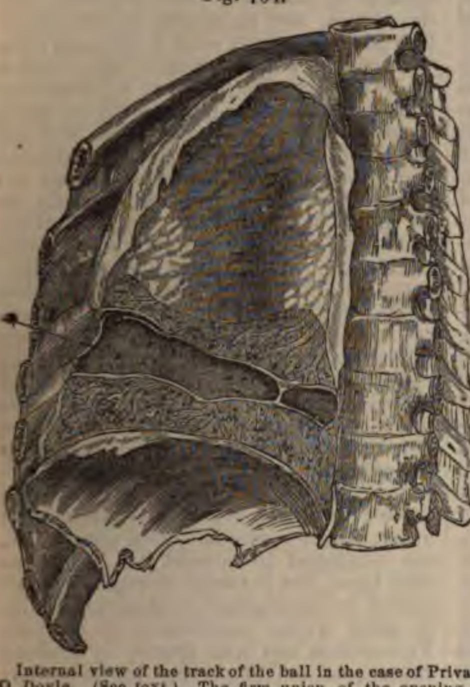
Fig. 763.



External condition of the wound of entrance in the case of Private O. Doyle. (See text.) The puckered and inverted portion of integument shown is firmly united to the cicatrix of the track through the chest-wall. From the *injured* rib there descends a firmly-connected and strong piece of bone, originally a splinter torn and pushed aside by the bullet, and this meets an exostotic growth from the *uninjured* rib below, so as together to form a column of support to the damaged structures above.

Treatment.—The object of the surgeon's care must be, in the first place, to arrest hemorrhage; secondly, to remove pieces, or jagged projections, of bone, or any other sources of local irritation; and, thirdly, to adopt measures for the prevention of all interference with the natural process of cure previously described. Although the shock may happen to be considerable, attempts to rally the patient, if any be made, should be conducted very cautiously; the prolongation of the depressed condition may be valuable in enabling the injured structure to assume the necessary state for preventing hemorrhage. [Aconite or veratria, or some arterial depressant should be used, if reaction threntens to become immoderate.] Hemorrhage from vessels belonging to the costal parietes should be arrested by ligature, as in other parts, if the source from which it proceeds can be ascertained, and if the flow of blood be so free as not to be controlled by pressure and ordinary styptics. If attempts at applying the ligature fail (and it is a difficult operation in the case of an intercostal artery—so much so, that a variety of instruments have been devised for the purpose of accomplishing this special object, though all of doubtful utility), the best plan is to plug the opening. This may be done without any risk of pushing foreign bodies into the cavity of the pleura, in the following way. A large piece of linen is laid upon that part of the chest in which the wound is placed, and the middle portion of this linen is pressed into the wound by the finger, so as to form a kind of pouch. This pouch is then distended by sponge or lint pushed into it until the pressure arrests the bleeding; on stretching out the corners of the linen cloth the pressure of the plug will be increased. The whole may finally be secured to the chest by a bandage or roller. [Styptics should be avoided, because they may, especially if in the form of powder, escape into the chest-cavity. Although lightly treated by many authors, wounds of the intercostal vessels are very dangerous. Eleven out of fifteen cases, reported as occurring during the late war in America, were fatal. Fortunately the complication is rare in gunshot wounds of the chest.

Fig. 764.



Internal view of the track of the ball in the case of Private O. Doyle. (See text.) The firm union of the opening of entrance in the lung to the opposite portion of the chest-wall, the track of the ball through the lung lined with false membrane, and the open ends in it of small bronchial tubes, are points worthy of note.

If compression by plugging does not stop the hemorrhage, the wound should be enlarged, any loose fragments of bone, if the rib be comminuted, removed, and the bleeding vessel secured by ligature. If these means fail, or are impracticable, the method suggested by Professor Gross should be tried—a small hole is drilled through the rib, and avoiding the pleura by keeping close to the bone, a silver wire is passed around the vessel. The wire includes in this way a portion of the bone, as well as the artery, vein, and nerve.

Wounds of the internal mammary artery are reported by Dr. Otis in five or six cases; five were fatal. The best plan of ligating this vessel is probably the one recommended by Goyrand.]

Hemorrhage from the lung itself must be treated on the general principles adopted in all such cases; the administration of cool acid drinks, iced, if ice can be obtained, perfect quiet, and the administration of opium or digitalis. When blood has accumulated in any large quantity, and the patient is so much oppressed as to threaten suffocation, all coverings must be removed, and the blood be permitted to escape by the wound; the wound should even be enlarged, if necessary, so as, with the assistance of proper position, to facilitate its escape. If the effused blood, from the situation of the wound, cannot be thus evacuated, and the patient be in danger of suffocation, then paracentesis must be resorted to.

The extensive early bleedings formerly recommended in penetrating gunshot wounds of the chest for the purpose of arresting internal hemorrhage are now rarely practised by English surgeons. Should the patient survive, the extreme drain thus effected appears to interrupt afterwards the process of adhesion between the pleural surfaces, and to arrest the steps which might otherwise be taken by nature to repair the existing mischief, while it leads the injured structures into a condition favorable for gangrene, or encourages the formation of ill-conditioned purulent effusions in large amount.

[In 8715 cases of penetrating wounds of the chest, reported in the Surgical History of the War, Part I., vol. ii., p. 612, hemorrhage occurred in 346 cases, and was fatal in 137. In addition to the means suggested to arrest hemorrhage, if it is excessive, bags of ice should be applied to the chest, and a teaspoonful of the wine or fluid-extract of ergot, with five or ten drops of the tincture of opium, given every twenty or thirty minutes. The wound should be left open and dependent, to allow the blood to escape from the chest-cavity. If the bleeding continues, and there is danger of fatal exhaustion from this cause, the wound should be closed, with the hope that coagulation will take place, and the flow be arrested by its hemostatic effect upon the bleeding part, and the application of cold to the chest, heat to the extremities, and the administration of ergot and opium continued. If the bleeding is controlled in this way, in five or six days, when danger of recurrence of the hemorrhage has passed, the wound should be opened and the effused blood permitted to escape.

In a case under my care, where the hemorrhage following a gunshot wound of the chest was excessive, and death from exhaustion imminent, the patient being cold, pale, and pulseless, a tablespoonful of spirits of turpentine, given undiluted by the mouth, brought back the pulse to the wrist, color to the face, and warmth to the surface, and at the same time arrested the hemorrhage. Dr. Fraser, in his monograph on Wounds of the Chest, was the first to show that venesection, to arrest hemorrhage in penetrating gunshot wounds of the chest, was useless and dangerous. Dr. Fraser's experience on this point is confirmed by that of the Federal and Confederate surgeons.]

If the wound be not attended with active hemorrhage within the cavity of the chest, if any bleeding there may have been from the external wound has been stopped, as soon as all splinters or other local sources of irritation have been cautiously removed, a pledget of lint should be laid over the opening, and a broad bandage placed round the chest, just tight enough to support the ribs, and in some degree to restrain their movements. An opening should be made in the bandage over the site of the wound, large enough to permit the ready access of the surgeon to it, if necessary, and to allow the escape of discharges. When there is only one wound, the patient should be laid on the wounded side, if his comfort admits of it, and with the wound downwards. This is done with a view to prevent accumulation of fluid in the pleura; and, at the same time, to allow freer action of the chest on the uninjured side for respiration. If there be two openings, as will most frequently be the case in rifle-ball wounds, one wound should be placed downwards in the manner just mentioned, and the wound which will then be uppermost should be kept covered. The most perfect quiet that can be obtained should be enjoined, and opium may be freely given for aiding this object.

When these arrangements have been carried out, the surgeon will next have to turn his attention to meeting the dangers of inflammatory action, especially in the pleura, lungs, and pericardium. [Trumatic pleurisy and pneumonia do not invariably follow gunshot wounds of the pleura and lung, as some writers have taught us to believe. As a prominent complication traumatic pleurisy is mentioned in only 94 cases, and traumatic pneumonia in 285 cases of penetrating, and 7 of non-penetrating wounds of the chest, in the Surgical History of the War, Part I., vol. ii., pp. 617 and 619.] The general treatment of pleurisy or pneumonia after a gunshot wound will not differ materially from the treatment of the same inflammations when arising from other causes. The chief difference in condition is that in almost all cases of penetrating wounds air will have been admitted into the pleura, and empyema, or sero-purulent effusions mixed with broken-up clot, will occur as a consequence. Here again of late years the practice of bleeding which was formerly enjoined in all such cases by military surgeons, not only as the best means of obviating internal hemorrhage (which has been already referred to), but also as the best remedy to be relied on afterwards for preventing and reducing inflammation, is now seldom resorted to. The use of calomel to salivation is also almost entirely abandoned. Everything calculated to lower the general strength is rather avoided. More reliance is placed on careful nursing, regimen, and dieting, and on restraining vascular excitement within due bounds, by the exhibition of medicines whose influence on the constitution is not of so permanent a character as is that of mercury. If the inflammatory action be excessive, small doses of tartarized antimony, digitalis, and the usual purgatives, are employed to combat it; but, even with these, the patient's strength is supported by appropriate means, especially in cases where suppuration is profuse. Venesection has been proved by modern experience not to prevent inflammation taking place, and has seemed to give it, when it has arisen, more power over the weakened structures. In the Crimean campaign, in which the circumstances of the period led for the first time army surgeons to depart from the doctrines so strongly enforced by Guthrie, Hennen, and other eminent military practitioners of the Peninsular period, not a few instances of favorable recovery took place after lung wounds without venesection being resorted to as any part of the treatment. The case of an officer of the 19th Regiment, who was shot at the assault of the Great Redan, and under the care of the writer, will serve to illustrate some of the points before named. In this instance, a rifle-ball passed through the upper part of the left scapula near its superior posterior angle, comminuting the bone and entering the chest. The ball, together with a piece of cloth, was excised in front, two inches above and internal to the fold of the axilla. The mouth was filled with blood immediately after the injury; bloody expectoration continued for three days; there was hacking cough on increased inspiration; the respiratory murmur was accompanied with slight crepitating *râles* in the upper part of the lung; there was weakness, but not much "shock." This officer, like almost all others who were then with the front of the army before Sebastopol, had been much weakened in frame by scorbutic diarrhœa in the winter of 1854-55, so that it appeared very objectionable to lower his vital force by any means; and though the cure was protracted by occasional attacks of diarrhœa subsequently to the injury, by profuse discharge from the wounds, and separation from time to time of spiculæ of bone, he left for England two months afterwards with his recovery nearly completed, and no inconvenience from the wound has been experienced in the discharge of his duties since. No venesection at all was practised in this case; but tonics, nourishing diet, and port-wine were given as soon as suppurative action had been established. The reports which have reached us from the United States, tend to show that bleeding was scarcely ever practised during the late war in that country for chest-wounds; indeed in the Circular from the Surgeon-General's Office before quoted, it is stated that "in the treatment of penetrating wounds of the chest, venesection appears to have been abandoned altogether."

While thus dwelling, however, on the successful treatment of chest-wounds without venesection, it is only right to mention that the opinion of some thoughtful surgeons in the Crimea did not coincide with the views of those who regarded bleeding as not only useless but injurious. Some indeed considered that more lives would have been saved had the lancet been used more freely.[1] In some instances in the Crimea the successful issues appeared to have been owing to copious venesection. A remarkable case in point occurred in a young soldier of the 33d Regiment, private Thomas Monaghan, under the care of Dr. Muir, who has since attained so eminent a position in the army medical service. The patient was wounded in August, 1855, through the left shoulder-joint and chest, the glenoid cavity and head of the humerus being injured, and the lung implicated. In this instance complete recovery as to the chest, and recovery with partial anchylosis of the shoulder, without operative interference, followed, and appeared attributable chiefly to inflammatory action being kept under by repeated venesection, the use of antimonial medicines, and enforced abstinence. In two other cases, which occurred during the same month under Dr. Muir's care, successful terminations appeared to be attributable to the use of similar means. In one of these the ball entered the front of the chest, between the third and fourth ribs, and passed out between the seventh and eighth ribs below; in the other, after passing through the right arm, it entered the chest at the posterior border of the axilla, and emerged near the apex of the scapula. More extended statistical information, with careful analysis of individual cases, is required before the question of the proper treatment of chest wounds, so far as venesection is concerned, can be regarded as a settled one. Perhaps when the whole of the vast experience recently gained in the War of the Rebellion in the United States, has been well collated and is made public, the question will be in a great measure solved.

[A careful examination of all the returns, confirms the statement of Dr. Otis made in Circular No. 6, S. G. O., that venesection for gunshot wounds of the chest "appears to have been abandoned altogether." Dr. Chisolm, in his excellent Manual of Military Surgery, is also opposed to venesection under such circumstances.

In A Manual of Military Surgery, issued for the use of the Confederate States Army, the practice of venesection in the treatment of chest-wounds was condemned as "unphilosophical and injurious." The Confederate military surgeons usually adopted at first an expectant, and later a supportive or restorative plan of treatment. Absolute rest, cool drinks, opium, quinine, milk, eggs, beef tea, and sometimes whiskey, generally constituted the treatment.]

A plan of treating gunshot wounds of the chest by hermetically sealing their external orifices, was introduced during the late war in America by Dr. Howard, of the United States Army. A description of the process, with the presumed objections to it in practice, may be found in a published lecture on the subject by the writer of this essay, in the Lancet of January 2, 1864. The Washington report before quoted has since commented on the plan as follows: "The record of the results of the so-called method of 'hermetically sealing' gunshot penetrating wounds of the chest are sufficiently ample to warrant an unqualified condemnation of the practice. The histories of the cases in which this plan was adopted have been traced, in most instances, to their rapidly fatal conclusion."[1] [It is to be hoped that the plan of hermetically sealing the external orifices of gunshot chest-wounds will never be imitated in the future.]

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[1] See the remarks on this subject in Dr. Macleod's Notes on the Surgery of the War in the Crimea, p. 237, London, 1858.

Gunshot Wounds of the Abdomen.

[Dr. Otis says that one-tenth of those killed in battle, perish from wounds of the abdomen, and that from three to four per cent. of all the wounded treated, are injuries of the belly.]

Gunshot wounds of the abdomen, like those of the chest, naturally divide themselves into *non-penetrating* and *penetrating*. The *non-penetrating* may be either simple flesh-wounds or contusions, or may be accompanied with fracture of some of the pelvic bones, or with injury to some of the contained viscera. In *penetrating* wounds, the peritoneum only, or together with it, one or more of the abdominal viscera, may be wounded; or, in comparatively rare cases, a projectile will so enter that a viscus is penetrated without the peritoneum being involved. It is in the regional cavity of the abdomen that the proportion of penetrating wounds is the greatest. The cranium, from its toughness, form, structure, and coverings, serves as a strong defence against penetration of the brain even by gunshot; the osseous yet elastic and movable ribs, the scapulæ, sternum, and the muscular parietes, with their convex outline, greatly protect the contents of the cavity which they enclose; but the extensively exposed surfaces of the abdomen, anteriorly and laterally, have scarcely any power of resistance to offer against a projectile impinging upon them; and when this important cavity is once opened by these means, whether the projectile lodges within it or otherwise, death is the usual result. Even the chances of a favorable termination which may exist in wounds from other causes are generally wanting in gunshot wounds; and much of the treatment, such as the use of sutures, and of other means that can be adopted to ensure the apposition of cut edges, is inapplicable here, from the parts to a certain distance being almost necessarily deprived of their vitality in injuries from gunshot.

Non-penetrating wounds are not proportionally so grave as their nearness to the peritoneum and the important organs invested by it might lead us to anticipate. Out of 115 non-penetrating wounds and contusions by projectiles of all kinds, in the English army during the Crimean campaign, 22 deaths occurred, or 19.1 per cent.; out of 328 similar cases in the French army, there were 54 deaths, or 16.4 per cent. The proportion of recoveries in the American returns appears at first sight to be much larger. They show only 114 deaths out of 2164 flesh-wounds and contusions of the abdomen, or 5.2 per cent.; but all cases in which the abdominal viscera were injured are excluded from these numbers, which probably explains the great difference between the comparative mortality shown in them and in the Crimean returns.

[The records of the late American war give 4469 gunshot flesh-wounds of the parietes of the abdomen, with 253 deaths; 258 gunshot contusions, with five deaths. S. H. W., Part II., vol. ii., p. 8.]

The fatal injuries which occasionally occur from masses of shell, or round-shot, in which the liver, spleen, or other viscera are ruptured without penetration of the abdominal parietes, and where death ensues from shock, hemorrhage, or peritonitis, have been alluded to in the general remarks. [Forty-one cases of gunshot injuries of the abdominal viscera, without external wounds, have been collected by Dr. Otis; of these twenty were fatal; and eleven cases from violence other than gunshot, of which ten died.] If the parietes have been much contused, abscess or sloughing may be expected; and a tendency to visceral protrusion must be afterwards guarded against, in case of recovery. The "Washington Circular," before quoted, mentions that the 114 deaths among the non-penetrating wounds resulted in most instances from sloughing after injury to the abdominal walls by shells.

Non-penetrating wounds complicated with fractures of pelvic bones are not included in the foregoing numbers. When these bones are fractured by heavy projectiles, and the injuries do not prove directly mortal, very protracted abscesses generally arise, connected with necrosed bone; and the vital powers of the patient are greatly tried by the necessary restraint and long confinement. The great force by which these wounds must be produced, and the general contusion of the surrounding structures, cause a large proportion sooner or later to end fatally, notwithstanding the peritoneal cavity has escaped from being wounded. Of 29 such cases which came under treatment in the English army in the Crimea, 16 died, or 55 per cent.; of 111 cases in the

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[1] Circular No. 6, p. 22, Washington, Nov. 1865. A reply by Dr. Howard to the remarks in the lecture published in the Lancet of Jan., 1864, appeared in the Amer. Journal of Med. Sciences of October, 1864.

French army, 81, or 72.9 per cent. Of 185 cases in the United States armies of which the results are published, 77 died, or 44.2 per cent.

[1494 cases of shot-fractures of the pelvis are reported, S. H. W., Part II., vol. ii., p. 255, with a mortality of 544, and 32 cases with the result unknown. From its extent and exposed position the ilium was injured most frequently, and the left ilium oftener than the right. 829 instances of shot-fractures of the ilium are recorded, with a mortality of 211. When the wound did not involve some of the contents of the pelvis, it was not often fatal. Of 86 injuries of the pubic bones, one-half perished—many of them because of some injury of the bladder. 73 cases of shot-fracture of the ischium, with 31 deaths; 145 of the sacrum with 62 deaths; and 17 of the coccyx with 6 deaths, are reported.]

Penetrating wounds.—The ratio of recoveries after these wounds in both the French and English armies in the Crimea was very small. Out of 124 penetrating wounds of the abdomen in the English army, 115, or 92.7 per cent. died; out of 121 in the French army, 111, or 91.7 per cent., died. The "Washington Circular," before quoted, states that of 543 cases in which "the peritoneal cavity was penetrated, or the abdominal viscera injured," the results had been ascertained in 414, and were fatal in 308, or 74 per cent.

[The returns from the late American war give 3717 cases of penetrating wounds of the abdomen; of these 3031 died; a mortality of 87.2 per cent. Altogether 8590 cases are reported of injuries of the abdominal region; this includes flesh-wounds, penetrating and perforating wounds, and injuries of the viscera without external wounds. Excluding 1690 of these cases where the result was unknown, the mortality of the remaining 6900 was 3327, or nearly one-half. Nine in every ten of those having penetrating wounds perished. S. H. W., Part II., vol. ii., p. 202.]

A penetrating wound of the abdomen, whether viscera be wounded or not, is usually attended with a great amount of "shock." When, in addition to the cavity being opened, viscera are penetrated, and death does not directly ensue from rupture of some of the larger arteries, the shock is not only very severe, but the collapse attending it is seldom recovered from, up to the time of the fatal termination of the case. This is sometimes the only symptom which will enable the surgeon to diagnose that viscera are perforated. The mind remains clear; but the prostration, oppressive anxiety, and restlessness are intense; and as peritonitis supervenes, pain, short and hurried respiration, diffused tenderness, irritability of the stomach, distension, and the other signs of this inflammation, are superadded.

[In an article on "Gunshot Wounds of the Peritoneum," by the writer, published in the Transactions of the Virginia Medical Society, 1873, four fatal cases of penetrating gunshot wounds of the abdomen without visceral injury are reported in detail. The absence of visceral injury was demonstrated in all of the cases by careful post-mortem examinations. In none of them was shock of injury or diminution of temperature appreciable. One of them, a soldier, assured me that he did not know that he had been wounded until some time after he was shot. Another, wounded in a duel, insisted that he was able to stand up and give his antagonist another fire, and I had some difficulty in convincing a third that his wound was serious enough to require quiet and absolute rest. I take the following from that article:—

"I do not remember one instance of penetrating wound of the abdomen, with visceral injury, where there was not a marked reduction in the force of the pulse, great and persistent diminution of temperature, and an expression of face indicative of serious injury, and I suggest that the presence or absence of *prolonged shock* in penetrating wounds of the belly, will enable us to decide the presence or absence of visceral injury. The size, force, and direction of the missile, position of the patient, and other collateral evidence, are not always sufficient to enable us to determine whether the viscera are injured or not. Probing the wound with the finger only to determine its extent and direction, and not with the view of operative interference, is bad surgery, and should be condemned."]

In the greater number of wounds from musket-shot, scarcely any matter will escape from the opening in the parietes, the margin of which becomes quickly tumefied; but if any escape, it will probably indicate what viscus has been wounded. If the stomach has been penetrated, there will probably be vomiting of blood immediately after the wound, and great pain and distress about the seat of injury, especially when the straining in vomiting occurs. If the liver be wounded, death usually results from primary hemorrhage, or from inflammation consequent upon extravasation into the peritoneum. In a few instances patients have recovered after gunshot wounds involving this viscus. About twelve instances altogether have been published by Guthrie, Hennen, Cooper, and others, who were engaged in military practice during the Peninsular campaigns. Only one case is known to have survived from the Crimean war; and, having had the opportunity of ascertaining the effects of the wound for several years after the date of the infliction, the writer has recorded the case in full in the fourth vol. of Army Medical Reports.[1] Two officers who were shot through the liver by musket-balls, during the Sepoy mutiny in India, recovered. The cases are described in the Indian Annals of Medical Science for January, 1859. Four instances of recovery during the late war in the United States are referred to in the Surgeon-General's report of 1865.

[79 cases of shot wounds of the stomach are reported as occurring during the late American war, and recoveries claimed in 19 cases; 64 of these cases were penetrating wounds of the stomach. After a very careful investigation of the cases of reported recoveries, Dr. Otis states that there was but one case of undoubted recovery. In this instance a fistulous opening in the abdominal walls communicated with the stomach, discharged for two months, and then spontaneously healed. Hæmatemesis was generally, but not invariably, a symptom of wound of the stomach.

173 cases of gunshot wounds of the liver are reported as having been under surgical observation; 62 are reported to have recovered. Dr. Otis states that in only 32 were the recoveries undoubted. Two recoveries are reported of wounds implicating the gall-bladder. S. H. W., Part II., vol. ii., p. 148.]

When the small intestines have been perforated, it occasionally happens that feculent matter escapes by the wound; in the majority of cases, however, no such evidence is afforded. If death follows soon after from peritonitis, the bowels usually remain unmoved, so that no indication is offered of the nature of the wound from evacuations; but in any case of penetrating wound of the abdomen, when the opportunity is offered, steps should be taken—a matter not unlikely to be omitted under the circumstances of camp-hospitals full of patients—to isolate and examine all evacuations which may follow. By attending to this direction, the writer had the satisfaction of ascertaining the subsequent passage of a ball and piece of cloth, in a case where the bullet had entered the loin near the spinal column and lodged.

Recoveries after penetrating wounds of the small intestines by gunshot are very rare. In the Army Medical Museum at Netley there is a preparation of jejunum, which was supposed to have been perforated in three places by a musket-ball. It was taken from a private of the 80th Regiment, who was shot through the abdomen at Ferozeshah, in 1845, and who died from cholera in 1851. Inspector-General Taylor, C.B., then surgeon of the regiment, who made the examination post mortem, thus described the injured part of the intestine: "The intestines, neither there nor elsewhere, were morbidly adherent, but the fold of intestines immediately opposed to the cicatrix presented a line of contraction, as if a ligature had been tied round the gut. The same appearance existed in two other places." It seems more likely that the gut was contused than perforated, and that the three constrictions which are still seen in the preparation, gradually supervened on the injury; more especially as no adhesions were found, and as, when the wound was inflicted, the symptoms were so slight as to have led to the supposition that the ball had gone round the abdominal wall.

Gunshot wounds of the large intestines, especially the ascending and descending portions of the colon, are less fatal than wounds of the small intestines; probably from structural causes, as well as circumstances depending on position, from the gut being so tied down that escape and diffusion of fecal contents into the peritoneal cavity is less likely to occur, and from its being only partially invested by peritoneum.

[Of gunshot wounds of the intestines 653 cases are reported, with recoveries in 118, in the late war in America. In speaking of gunshot wounds of the small intestines, Dr. Otis says, "it may still be considered doubtful if an incontestable instance of recovery was observed." Most of the cases of reported cures were in wounds of the large intestine; of these the descending colon gave the largest number, and the transverse portion the smallest—41 of the reported recoveries are indisputable.]

An occasional result of a gunshot wound of the intestines, more especially of the colon, is fecal fistula, and, by means of this way of escape for fecal and other discharges, life is sometimes saved. One such case only occurred in the Crimea, and this happened in the 19th Regiment, of which the writer was then the surgeon. This case subsequently passed under the care of his friend Mr. Birkett, of Guy's Hospital, in which institution the patient died from the effects of albuminuria, four years after the receipt of the wound referred to. The surgical history of this case has been already published in the Lancet;[1] the medical history, together with the results of the post-mortem inspection, have been detailed by Dr. Habershon, in vol. v., ser. iii., of the Guy's Hospital Reports. The fistula became closed at intervals, and occasionally, before other disease supervened, hopes were entertained that complete recovery might result. The direction and depth of the wound precluded any of the usual operations for attempting to effect a radical cure. Two cases of abnormal anus by shotgun perforation were recorded by Dr. Williamson, among the wounded who returned from India after the Sepoy mutiny; in both instances the descending colon was the part of the bowel implicated. The Washington report states that fecal fistulæ were produced in many survivors after gunshot wounds of the abdomen, and gives the particulars of eight such cases. It further states that the fistulæ "commonly closed after a time without operative interference, reopening at intervals and then healing permanently."[1]

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[1] History of a case of gunshot wound of the liver, with remarks, Army Med. Dept. Reports, p. 502, London, 1864.

[1] For 1855, vol. i., p. 606, and vol. ii., p. 437.

[In the late war in America, nearly all the cases of recoveries after gunshot wounds of the large intestines, were attended by fecal fistulæ: generally after a longer or shorter period the opening spontaneously closed.

In 59 cases of stercoral fistulæ (Surgical History of the War) 9 remained open and 50 closed; 17 of these cases in less than a month; 28 in less than a year; in 5 the opening closed in from one to four years.]

If the kidneys or bladder are so wounded that there is a direct communication between the wound and the sac of the peritoneum, a fatal result is almost inevitable from inflammation; but if they are wounded in such a way as not to include their peritoneal investments, they have not the same fatal character. When the bladder is opened by a projectile which does not perforate the viscus, the lodgment of the latter within it is almost a necessary consequence. Mr. Dixon, of St. Thomas's Hospital, published in the 33d vol. of the Medico-Chiurgical Society's Transactions a list of all the cases in which the operation of lithotomy was known to have been performed for the extraction of bullets, or of calculi of which bullets formed the nuclei, up to the date at which he wrote. They were 15 in number. The lodgment of a bullet was ascertained to have happened in a soldier of the 20th Regiment, in the Crimea; but the patient died from other injuries, so that the information could not be turned to account. A case which occurred during the late war in the United States is noted in the Washington report, in which a fragment of a grenade, weighing upwards of 2 oz., was extracted by lithotomy; the fragment had reached the bladder through the right natis. Small foreign bodies may also pass into the bladder by way of the ureter. Mr. Guthrie mentions some wounds of the kidney where recovery took place; in one, seven months after the wound, after an attack of retention of urine, a piece of cloth was forced out by the urethra, which must have come down from the pelvis of the kidney.

[Of the 78 cases of gunshot wounds of the kidney in the Reports to the Surgeon-General of the United States Army, 26 are said to have recovered. There is reason, however, to doubt the verity of diagnosis in some of these cases. The right kidney was injured in 13 cases, the left in 12 cases, and in one it is not noticed. Hematuria is mentioned in 15 cases. Dysuria, lumbar pains, retraction of testis, etc., are reported in some of the cases.

Asst.-Surgeon R. T. Perry, P.A.C.S., in the Confederate States Medical and Surgical Journal, vol. i., p. 75, reports a case of undoubted recovery after gunshot wound of the left kidney. 183 cases are recorded of gunshot wound of the bladder in the S. H. W., Part II., vol. ii., p. 264; 87 of these, or 47.5 per cent., survived, but among those who survived the immediate effect of the wounds, there are many instances where the injury, after months of great suffering, from urinary fistulæ and other painful infirmities, eventually proved fatal.

To the *sixteen* cases, which Dr. Otis says Mr. James Dixon has enumerated in the volume referred to by Prof. Longmore, 13 additional cases of lithotomy by American surgeons, for the removal of projectiles, or of concretions formed about projectiles, have been collected by Dr. Otis. Three more European cases should be added to the collection of Mr. Dixon, making 32 examples of this kind recorded by Dixon and Otis. Two of the operations of lithotomy collected by Otis were performed by the writer, and since then he has added a third case (Virginia Medical Monthly), Nov. 1875, making up to this time 33 recorded examples of cystotomy for the extraction of missiles, or of calculi formed around missiles or other foreign matters.]

Instances are recorded in which balls have passed directly through the abdomen without perforating any important viscus. As an example, on the other hand, of the number of wounds which may thus be inflicted, a soldier of the 19th Regiment, on duty in the trenches before Sebastopol, who was shot through the abdomen in the act of defecation, was found by the writer, on post-mortem examination, to have had as many as sixteen openings made in the small intestine. He survived the wound nineteen hours.

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[1] Circular No. 6, p. 25.

Wounds of the diaphragm. — Musket-balls occasionally pass through the diaphragm, and Mr. Guthrie has remarked that these wounds, in instances where the patients survive, only become closed under rare and particular circumstances. Hence the danger of portions of some of the viscera of the abdomen, as the stomach or colon, passing into the chest, and thus forming diaphragmatic herniæ; and of these eventually from some cause becoming strangulated. Two very interesting preparations of these accidents from gunshot exist in the Museum at Netley. In both instances, the stomach, colon, and omentum form the hernial protrusions. In one, death occurred a year after the wound, from strangulation induced suddenly after a full meal; in the other the soldier continued at duty twenty-two years after the wound, and then died from other causes. All the cases which occurred in the Crimea, in which openings had thus been established between the cavities of the chest and abdomen, proved fatal. One case occurred where the patient survived a double perforation of the diaphragm, together with a wound of the liver, six days; in another instance, where the lung, diaphragm, liver, and spleen were wounded, the soldier lived sixteen hours. The apparent direction of the ball, hiccough, dyspnœa accompanied with spasmodic inspiration, and inflammatory signs more particularly connected with the chest, will be the usual indications of such a wound. In case of recovery, the risk of hernial protrusion and strangulation should be explained to the patient. Should strangulation occur, it can hardly be expected that division of the stricture could be performed, without the operation itself leading to nearly as certain fatal results as the condition it would be employed to remove.

Treatment.—In the treatment of most penetrating wounds of the abdomen by gunshot, the surgeon can do little more than soothe and relieve the patient by the administration of opiates; and, if the patient survives long enough, to treat symptoms of inflammation when they arise on the same principles as in all other cases. The removal of a soldier wounded in the abdomen from the place where he has fallen should always be conducted in the most easy and cautious manner; and before the transport is commenced a full dose of opium or morphia should be administered to him. The advisability of an early administration of a dose of morphia may be taken as a general rule for all such cases. The use of this remedy is most important, not merely to allay pain and nervous excitement, but also to stop the peristaltic action of the intestines as much as possible. By its aid, if an opening has been made in a part of the intestine, perhaps escape through it of the bowel contents into the peritoneal cavity may be prevented; and if the opiate treatment be continued at intervals, and perfect rest enjoined after the man has arrived at hospital, perhaps such a state of quiet may be produced at the seat of injury, that the wounded parts may become isolated, and agglutinated to neighboring structures by effused lymph, so as to stop further communication with the general cavity of the abdomen. No brandy or other stimulant should be given: the collapse which attends such injuries may be useful in checking hemorrhage; and the exhibition of stimulants is further contra-indicated by the risk of exciting too much reaction, should the wound not prove directly fatal. The diet and drinks should be most limited in quantity; indeed, for the first two or three days nothing but a little water should be allowed. In short, all the early treatment should be directed to insuring rest, as complete as possible, not merely of the patient generally, but also local rest—most especially of the abdominal viscera which may have been involved in the injury—and, at the same time, to limiting inflammatory action in the wounded serous sac to the narrowest bounds.

If the wound be one in which intestine protrudes, and the latter be found to be entire, it must be dealt with on the same principles as protrusions after incised or ordinary torn wounds; but if the protruding intestine is found to have been opened by the projectile, or if from the length of time which has elapsed before the constricted bowel has been brought to the notice of a surgeon it has become gangrenous, not simply congested, the part so wounded or so gangrenous should not be returned. Steps in such a case must be taken to try and form an artificial anus, and so to imitate the usual means of natural cure when recovery follows a gunshot wound with penetration of intestine. It must be remembered that sutures are not to be applied to the edges of a gunshot wound without previously paring them and removing the parts which have been contused by the action of the projectile.

When the bladder is penetrated, care must be taken to provide for the removal of the urine, either by an elastic catheter, or, if this cannot be retained, by perineal incision. A freely communicating external wound prevents the employment of the catheter from being essential. A soldier of the 57th Regiment was wounded on the 18th of June, 1855, by a musket-ball, which entered the left buttock, fractured the pelvis, and came out about three inches above the os pubis, and one inch to the right of the median line. The bladder was perforated; urine escaped by both openings, chiefly by the one in front. Here the catheter caused so much irritation that it was withdrawn; but the posterior wound soon ceased to discharge urine, and in eighteen days the anterior wound was free from discharge also. Seven weeks after the date of injury, symptoms resembling those of stone in the bladder came on; these were relieved on three spiculæ of bone making their escape by the urethra. About the same time the anterior wound became again open, and some pieces of bone were discharged. After 97 days' treatment in the Crimea, the man was sent home; the anterior wound being still so far open that distension of the bladder, as from accumulation at night-time, led to a little oozing from it. This subsequently healed, and he was sent to duty on the 22d of November, nearly six months after the date of injury.

[In non-penetrating gunshot wounds of the abdomen, the surgeon should remember the proximity of the peritoneum, and the possibility of inflammation of that structure. I have seen fatal peritonitis follow simple contusion of the anterior abdominal wall, from a fragment of shell. If the wound is in the region of the epigastric, circumflex iliac, mammary, or lumbar arteries, hemorrhage may be sufficient to require ligation of the vessel. In such cases it is better to look for and tie both ends of the bleeding vessel than to trust to compresses and styptics. Sometimes retraction of the artery makes it difficult to find, but if necessary, the wound should be enlarged for this purpose. Six cases of non-penetrating wounds of the abdominal parietes (five from balls and one from a piece of shell) are reported as having perished from hemorrhage during the late American war. Styptics, compresses, and cold applications were resorted to in these cases.

Occasionally the blood does not escape by the external opening, but makes its way into the cellular tissue, dissecting up the muscles and aponeurotic planes, and forming a tumor. If the tumor is small it may be absorbed; but it may, especially if the deposit of blood is large, end in abscess and sloughing. Under such circumstances the tumor should be opened, the blood evacuated, and the bleeding vessels ligated. Acupressure may be resorted to when there is no danger of wounding the peritoneum. Foreign bodies, such as balls, pieces of clothing, buttons, etc., which have lodged in the walls of the belly, should be removed, as their presence may provoke abscess, sloughing, and peritonitis. The doctrine that "it is often better to let them alone unless they prove troublesome," is unsafe, as foreign bodies in the abdominal wall rarely become encysted. After arrest of the bleeding, and extraction of foreign bodies, a pledget of lint, wet with water containing a small quantity of carbolic acid, should be applied to the wound and retained by adhesive plaster or the roller bandage, and absolute quiet enjoined.

When a ball passes for some distance under the skin, or the skin and first layer of muscles of the abdominal wall, it makes what has been called a "seton wound." A reddish-blue line in the skin marks the track of the ball. When a wound of this character is very long, it may become necessary to open it throughout some portion of its extent to permit the escape of pus. Sometimes the missile makes a "furrowed wound" of the abdominal parietes. The cavity may be laid open by a wound of this kind without injury to the viscera. Foreign bodies, as dirt, hair, etc., should be removed, and the wound brought together as nearly as possible by sutures. If the peritoneum is wounded, it should be included in the sutures.

The most extensive wound of the abdominal parietes that I ever saw, where recovery took place, was in the case of Col. Snowden Andrews, who was wounded at Cedar Run, August, 1862. While in command of the artillery of Jackson's division, Confederate Army. A shell from a Federal gun exploded very close to his body, and a fragment struck him one and a half inches below, and a little to the right of the ensiform cartilage, and passed downwards towards the right anterior superior spinous process of the ilium. The missile fractured three of the ribs on the right side, tore off the anterior superior spine and a part of the crest of the ilium, and laid open the cavity of the belly from the point where it struck an inch and a half below the ensiform cartilage, to a point an inch below the superior spinous process of the ilium. After leaving the abdomen it made a deep flesh-wound in the upper and outer part of his right thigh. He fell from his horse into the road, and when found was lying on his back, with a large mass of his bowels protruding from the abdomen and hanging over his side on the ground. The weather was very dry, and large bodies of infantry and artillery had passed over the road, which was covered several inches deep with finely-powdered earth. The protruded bowel was literally covered with dust. As there were many wounded at this time, and it was supposed Col. Andrews would soon die, he was sent in an ambulance three miles to the rear, and placed in a farm-house. That night, three hours after he had been wounded, Drs. Amus and Walls, of Virginia, removed from the abdomen some pieces of cloth; washed the dust and dirt from the intestines with warm water; returned the bowel, which was uninjured, and sewed up the wound. He recovered and returned to duty in the field eight months after, commanding a battalion of artillery at Chancellorsville, May, 1863, and serving to the end of the war. He is still living, and consulted me a short time ago about a hernial protrusion which has recently taken place along the line of the cicatrix.

When a bowel protrudes through a wound in the walls of the abdomen, and becomes distended with gas and constricted by the edges of the wound, so that it cannot be made to recede, prolonged gentle pressure with the finger and thumb will generally force the gas into some part of the intestines within the abdomen, and the protruded mass can then be replaced. If this cannot be effected, the abdominal wound should be enlarged. The gut should never be punctured, as has been proposed, to allow the gas to escape.

When the protruded bowel is wounded, and the edges of the intestinal wound are ragged, they should be pared with the knife or scissors, and then brought together with sutures. Lembert's suture is probably the best for this purpose, as it slightly inverts the external coat of the bowel and brings its serous surfaces into contact. Adhesion takes place more readily in this way than when the mucous surfaces or even raw surfaces are brought and retained in apposition. After the intestinal wound is closed, the bowel should be put back into the abdomen, and the edges of the external wound brought together with deep interrupted, or the quilled, or Bozeman's button-suture, as the case may demand.

The question has not yet been decided as to what should be done when the wounded bowel does not protrude through the opening in the walls of the abdomen in gunshot injuries of that region. By the expectant plan of treatment advocated by most surgeons, it is hoped that no extravasation of blood or feces has taken place at the time of the injury, and that by giving morphia hypodermically, which is much the best plan of administering this invaluable agent in all of these cases, peristaltic action of the bowels will be arrested, pain allayed, and the inflammation which follows be restricted to the degree necessary only for the effusion of lymph; that the peritoneum covering the intestine at and near the wound will become adherent to the omentum, or to an adjoining loop of bowel, or to the inside of the wall of the abdomen, and the orifice in the bowel become permanently closed in this way.

Another plan of treatment urged by Legouest and other military surgeons, is to enlarge the wound in the abdominal parietes, or lay open the abdomen along the linea alba; tie all bleeding vessels; search for the wounded bowel by carefully examining the whole length of the canal; sew up the wounds in the bowel, previously trimming the edges, if they are lacerated and ragged. After this the cavity should be cleansed of blood, feces, and other extraneous matters, and the abdominal walls closed with sutures, adhesive plaster, and bandages.

Recoveries following the first, or expectant plan, are so rare that Dr. Otis says: "Authenticated examples can be counted on the fingers." Nine examples of enteroraphy for shot wounds of the bowel are recorded. In one instance, success was complete; three recovered with fecal fistulæ; in five, death was the result. Dr. Otis adds to this report the following, in which I fully concur: "Already interference contrasts favorably with the do-nothing system. Reflection upon the results of ovariotomy, upon the results of gastroraphy and enteroraphy applied to protruded wounded viscera, leads unavoidably, in the writer's opinion, to a conviction of the propriety of incising the abdominal wall, when necessary, in order to expose and sew up the wounded gut, concealed within the cavity, whether divided by a cutting instrument, or by shot. The obstacles to success are obvious; but it is a mortal peril which demands an extreme remedy." S. H. W., Part II., vol. ii., p. 128.[1]

The dangers of gunshot wounds of the pelvis have been generally overstated by writers on military surgery. While the fatality of penetrating shot wounds of the abdomen is so fearful, more than three cases out of every four dying; in shot wounds of the pelvis, unattended by severe visceral injury, three cases out of four get well. The smaller mortality in pelvic wounds is chiefly due to the more perfect drainage which the character and position of the wound permit. The external orifice should be kept open and dependent, so that free vent may be given to all inflammatory products, and if the size and position of the wounds do not facilitate this, the opening may be enlarged and the drainage-tube used.

The wound should be explored with the

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[1] See Dugas, Trans. Internat. Med. Cong., Phila., 1876, and McGuire, Trans. Am. Med. Assoc., 1881. By the latter, *drainage*, after operative interference in shot wounds of the belly, is advocated.

finger, loose pieces of bone and all foreign bodies removed, if possible. A soft, pure gum catheter should be introduced and retained in the bladder for several days, if urinary extravasation is apprehended. When fracture of bone is extensive, a broad bandage fastened around the pelvis gives the patient great comfort.]

GUNSHOT WOUNDS OF THE PERINEUM AND GENITO-URINARY ORGANS.

From the position of these parts of the body, uncomplicated gunshot wounds of them are comparatively rare. Fifty-six cases, however, occurred among the soldiers of the English army in the Crimea, from the 1st of April, 1855, to the end of the war; and among these were 17 deaths, or 30.3 per cent.; while out of 234 in the French army, there were 77 deaths, or 32.9 per cent. Out of 457 cases of genito-urinary wounds noted in the "Washington Circular," before quoted, there were 37 deaths, or only 8 per cent. The deaths among the men in the English army chiefly resulted from extensive laceration involving the urinary apparatus. Three men only, out of 935 who have been invalided on account of wounds received in the Indian mutiny, were sent home for wounds of this class. In one of these the injury was from a spent shot, which caused a bruise without laceration over the symphysis pubis, and produced persistent incontinence of urine; in each of the other two, a musket-ball wounded the left testicle, injured the urethra, and led to urinary fistula. The fistulæ were, however, subsequently cured. In one patient the testicle was so much injured that it was removed on the day the wound was received; in the other, it sloughed away shortly after.

Perineal wounds are not unfrequently caused by shells bursting and projecting fragments upwards; but they are generally mixed with lesions of viscera of the pelvis, or fracture of its structure, or extensive laceration often involving the upper parts of the thighs or buttocks. Separate wounds of the external organs of generation are usually caused by bullets, which often pursue very curious tracks through their structure. In two cases in the Crimea a bullet entered between the glans penis and prepuce, and traversed upwards without penetrating the erectile tissue. M. Appia records a case where the ball entered the summit of the glans, traversed the whole length of the corpus cavernosum, passed under the pubic arch, and went out by the right buttock. The urethra was not opened. In another case, a ball carried away the inferior part of the glans, but did not wound the urethra. A soldier of the Rifle Brigade was wounded in the Crimea by a musket-ball, which entered the right buttock and came out by the body of the penis, just below the glans. In this case the urethra was ruptured about four inches from the meatus. The wound of the penis closed favorably. When one lateral portion of the corpus cavernosum is perforated by a bullet, the loss of substance, and the contraction caused by the process of cicatrization, lead to such distortion when the organ is distended, as not only to cause pain but also to render sexual intercourse impracticable. Operative interference becomes necessary to remedy this condition. The fact of bullets occasionally lodging in the scrotum should be remembered in cases of wounds about the perineum and genito-urinary organs, when the site of lodgment of a projectile cannot be readily discovered.

[*Numerical Statement of Three Thousand One Hundred and Seventy-four Cases of Injuries of the Pelvis reported during the War.*

Nature of injury.	Cases.	Recoveries.	Deaths.	Result unknown.
Shot fractures of the pelvis	1494	918	544	32
Punctured and incised wounds	15	12	3	
Shot penetrations of the pelvic cavity without known injury to the viscera	38	25	13	
Shot wounds of the bladder	185	89	96	
Shot wounds of the prostate	8	4	4	
Shot wounds of the rectum	103	59	44	
Wounds of pelvic nerves and bloodvessels . .	179	94	85	
Shot wounds of the penis	309	268	41	
Shot wounds of the urethra	105	83	22	
Shot wounds of the testis	586	520	66	
Shot wounds of the spermatic cord	32	30	2	
Shot wounds of the genital organs indefinitely described	120	104	13	3
Total	3174	2206	933	35

The above table is taken from the Surgical History of the War, Part II., vol. ii., p. 423.

Other parts were generally implicated in gunshot injuries of the prostate. In one case the ball lodged in this gland. Persistent priapism lasting for many days followed in one instance. Painful micturition and defecation attended wounds of this gland.

The record of wounds of the rectum showed that gunshot injuries of this portion of the alimentary canal were not nearly so dangerous as wounds of the bowel higher up. In the fatal cases pelvic fracture was generally present. Dupuytren's suggestion of division of the sphincters to prevent or cure fecal infiltration and fistulæ following gunshot wounds of the gut was resorted to in several instances.

A large majority of the deaths following gunshot wounds of the penis were due to other injuries received by the patients, such as fracture of the pelvis, femur, etc. Two of the cases died from tetanus. Several instances are reported of balls lodging in the penis, and being removed by excision.

A large proportion of the twenty-two fatal cases in shot wounds of the urethra were attended by other injuries. In three cases death resulted from hemorrhage. In eight cases urinary infiltration, and in nine instances surgical fever, with profuse suppuration, was the cause of death. Stricture and urethral fistulæ often followed wounds of this canal.

Shot injuries of the testis were frequently complicated with wounds of the penis, thighs, or pelvis. In the large majority of the fatal cases, death was due to some complication. Excision of one or both testes was performed in 61 instances, with a mortality of 18 per cent. When treated on the expectant plan, the death-rate was 11.9 per cent. Neuralgia and atrophy were common sequences of gunshot wounds of the testes.]

Gunshot Wounds of the Extremities.

These injuries, always very numerous in warfare, offer many subjects of consideration for the military surgeon. No class of wounds includes so many cases that remain under his care for long periods as this class. As already shown, a large proportion of wounds of the head and trunk are immediately fatal, or from the commencement contain the elements of fatal results, while wounds of the extremities, if those of the thigh be excepted, are free from this extremely serious character. The treatment to be pursued, including questions of conservation, resection, amputation, and the proper time for the adoption of these latter, if determined upon, often demands the closest attention of the surgeon. These subjects will be considered in their general bearing in other parts of this work, and only points especially connected with the circumstances of warfare will be here referred to.

Gunshot wounds of the extremities divide themselves into flesh-wounds and contusions, and those complicated with fracture of one or more bones. Flesh-wounds may be simple, and these offer few peculiarities, whatever their site; or they may be accompanied with lesion of important nerves, or bloodvessels, or both, and these complications generally entail serious consequences. The latter usually increase in gravity in proportion as the injuries approach nearer to the trunk.

When a gunshot wound of an extremity is complicated with fracture, the lesion is usually rendered compound by the direct contact of the projectile with the injured bone. Occasionally the fracture is simple; when this happens, it is generally caused by indirect projectiles, such as stones or splinters, or by spent balls.

The following complications, in addition to those already mentioned, not unfrequently accompany injuries of this class as they are met with in military practice: extensive laceration of soft parts; lodgment of the projectile, either entire or in fragments; injuries to distant organs from the projectile continuing its course into the trunk; and lastly, extension of fissures from the seat of fracture into an articular extremity, and consequent opening of a joint. The serious aggravation of injury which constantly occurs from the mischievous effects of transportation from the place where a soldier has fallen to the field-hospital, and again subsequently from the field to the general hospital in rear, must also be taken into account when estimating the conditions and results of gunshot fractures of the extremities under the circumstances of warfare. The critical influence which is exerted upon a shattered bone with an open wound, or upon an articulation penetrated by gunshot, by the distance the patient has to be carried, and by the kind of means employed for effecting the transportation,[1] and the paramount importance in military practice of preventing local movement of the parts involved in such injuries, by plaster of Paris or other closely adapted and immovable supports, can hardly be said to have yet attracted sufficient general attention in England.

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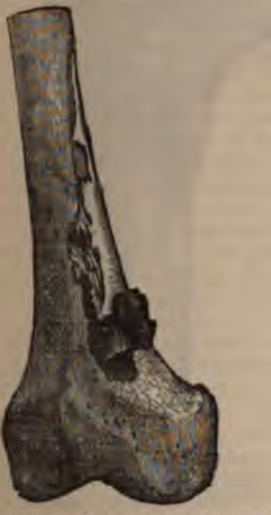
[1] See, on this subject, A Treatise on the Transport of Sick and Wounded Troops, pp. 514, London, 1869, by T. Longmore, printed under the superintendence of H. M.'s Stationery Office, and sold by Longman & Co., etc.

Simple flesh wounds have already been referred to both in respect to their nature and treatment in the commencement of this essay. It is in connection with fractures of bones and their proper treatment that the interest of surgeons is chiefly attracted to gunshot wounds of the extremities. From the nature of the injuries, already described, to which bones are subjected by the modern weapons of war, together with the irreparable nature of the wound in the softer structures, except after a long process of suppuration and granulation, as well as from the usual circumstances of military practice, it might be anticipated that difficulty would often arise in determining which of the double set of risks and evils—those attending amputation, and those connected with attempts to preserve the limb with a profitable result—would be least likely to prove disadvantageous to the patient. Experience in such injuries has established certain rules which are now generally acted upon; some still remain *sub judice*.

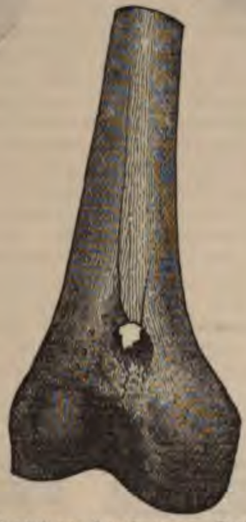
Some of the varieties of fractures which result from gunshot in the long bones of the extremities can scarcely be produced by any other agents besides projectiles. This fact is chiefly observed among partial fractures, which are rare accidents in civil practice, while in military practice they are by no means uncommon. Thus military surgeons meet with the following instances of partial fracture: 1. Removal of portion of a bone by the projectile making a furrow in its passage across its surface—grooving it: 2. Removal, splintering off, of longitudinal fragments from the external cylindrical part of a bone; 3. Removal of part of the bone by completely punching out a portion, thus leaving a hole through the entire substance of the bone; and 4. Partial fracture by driving inwards part of the external cylinder, and causing the fragment to lodge in the cancellated structure. This latter

Fig. 765.



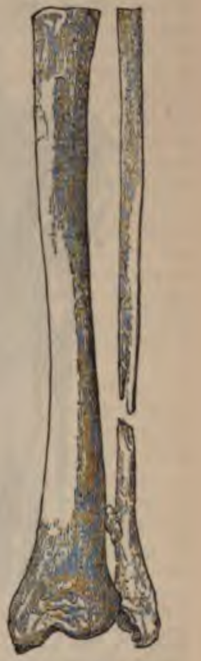
Partial gunshot fracture. Lateral splintering. (See remarks in the text.)[1] The bullet lodged; the lead being cut into, and a thin segment turned back by the sharp edge of the fractured bone.

Fig. 766.



Partial gunshot fracture. Perforation with fissuring. (See remarks in the text.)[2]

Fig. 767.



Resecting gunshot fracture of the fibula. The natural stay, or buttress of bone below the seat of injury, which has been thrown out to support the lower fragment, is worthy of note.[3]

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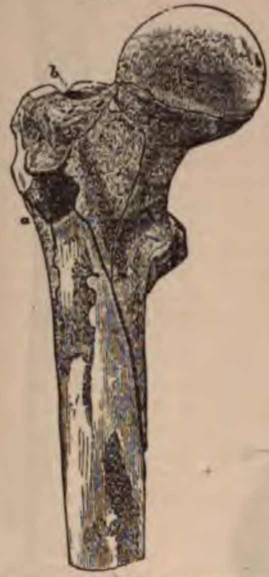
[1] Spec. No. 132 in the Army Medical Museum at Washington.

[2] Spec. No. 76 in ditto.

[3] Spec. No. 3692 in the Army Medical Museum at Netley.

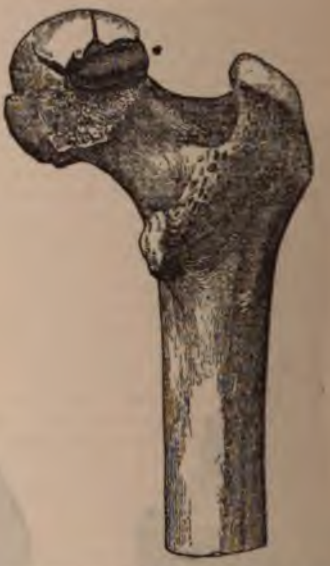
partial fracture is generally attended with lodgment of the projectile also. Among the complete fractures, those attended with general comminution in the neighborhood of the part of the bone struck, with dispersion of the fragments among the surrounding soft tissues, and those which may be spoken of as "resecting fractures," can hardly be caused accidentally, except by fire-arm projectiles. The latter fractures result when a rifle-ball at high speed strikes one of the smaller long bones of the extremities, as the fibula, one of the bones of the forearm, one or two of the metacarpal or metatarsal bones, without coming into collision with the adjoining bone or bones of the same portion of the extremity. In such a case, a portion of the bone struck, including its entire circumference, is liable to be cut out of it, to be "resected," leaving the broken surface of the remaining upper portion of the shaft separated by a certain interval from the broken surface of the lower portion. This is a noticeable fracture, for the impossibility of bringing the two broken surfaces into contact with each other has a material influence, when a certain limit of separation is passed, in preventing any process by which they can become united. The drawings (Figs. 765, 766, 767) will serve to illustrate some of the kinds of special fracture above mentioned.

Fig. 768.



Upper portion of right femur, showing the injury produced by a conoidal bullet. The projectile has entered at the trochanter major and made its exit upwards through the posterior part of the neck of the bone.[1]

Fig. 769.



Upper portion of right femur, showing the injury produced by a conoidal bullet which has penetrated the head of the bone.[2]

When conoidal bullets happen to strike on or below the trochanters of the femur, they usually leave the head and neck of the bone intact, but cause fissures which often extend to a long distance down the shaft; when they pierce the head, all the parts below usually escape fracture; when the neck is perforated, the fracture generally extends both upwards and downwards. The same rule holds good with regard to the upper articulating extremity and tubercles of the humerus, but not in so marked a manner, owing to the modified form and development of the corresponding parts in this bone. When, therefore, in a wound about the hip or shoulder-joint, an observation by the finger of the particular spot which has been struck is practicable, a recollection of the circumstances just mentioned facilitates the diagnosis of the probable extent of the injury effected, and furnishes a point for consideration when settling the treatment to be adopted. The drawings (Figs. 768 and 769) serve to illustrate fractures produced by conoidal balls which have penetrated the greater trochanter and head of a femur.

Although the subject of pyæmia is considered in its general bearings elsewhere, it is right to mention here that this serious complication, as met with in gunshot wounds, appears to be especially induced by injuries of bones, particularly those of long bones in which the medullary canal has been laid open and extensively splintered. Several circumstances probably conduce to this result: its chief local causes are the prolonged suppurative action during the removal of sequestra, the irritation caused by sharp points and edges, sometimes increased by transport from primary to secondary hospitals, the patulous condition of veins in bones, leading to thrombosis; while depressed vital power from any cause, and continued exposure to an impure atmosphere from the congregation of numerous patients with suppurating wounds, are the principal agents in producing the state of constitution favorable to its development and progress. Unless the hospital miasmata engendered in this way are constantly removed as they arise, or, at least, very greatly diluted, by proper ventilation, it it is almost impossible that patients laboring under severe wounds of the extremities with comminuted bony fractures can be long saved from septicæmia and pyæmia; and these, when they supervene, rarely lead to any but a fatal termination. The different conditions of hospital air, which in one set of cases lead to the appearance of hospital gangrene, in another set to that of pyæmia, have not been properly defined; but from the frequency with which the latter complication follows wounds of bones, it would seem that an especial influence is exerted by the local peculiarities, already mentioned, of these injuries. Observation would also lead to the belief that certain individuals are much more predisposed to pyæmic action than others placed under similar circumstances. Occasionally, in gunshot injuries of bones, where no splintering has occurred, but only a small portion of the periosteum has been torn off and the shaft contused by the stroke of a bullet, severe inflammation will follow, the medullary canal become filled with pus, and death ensue from pyæmia. The attention of surgeons has been particularly called to the various circumstances producing inflammation and suppuration of the medullary tissues—osteo-myelitis—in long bones after gunshot injuries, by M. Jules Roux, of Toulon.[1]

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[1] Spec. 710 in the Army Medical Museum at Washington.

[2] Spec. 125 in ditto.

Upper extremities.—Fractures of the bones of the arm are well known to be very much less dangerous than like injuries in the corresponding bones of the lower extremity. Unless the bone be extremely injured by a massive projectile, or longitudinal comminution exist to a great extent, especially if also involving a joint, or the state of the patient's health be very unfavorable, attempts should always be made to preserve the upper extremity after a gunshot wound. In the history of the British army in the Crimea, the recoveries without amputation are shown to be, in the humerus 26.6; radius and ulna, 35.0; radius only, 70.0; ulna only, 70.0, per cent. of cases treated. The proportion of deaths in the cases in which conservative treatment was adopted, was humerus, 8.6; radius and ulna, 2.8; radius only, 7.7; ulna only, 5.2 per cent. Dr. Chenu's returns show a much larger percentage of deaths in the corresponding cases in the French army. Out of 334 cases of fracture of the humerus treated without amputation, 88 died, or 26.3 per cent.; out of 177 cases of both bones of the forearm, 34 died, or 19.2 per cent.; 143 cases of the radius only, 27 died, or 18.6 per cent.; 125 of the ulna only, 16 died, or 12.8 per cent. But so many cases of wounds of the upper extremity are not included in the above figures, from their particular nature not having been recorded by the surgeons in the field, that, had the whole number been available, the proportions stated might have been materially changed. The statistics of the gunshot fractures of the upper extremity inflicted during the late war in the United States are not yet completed.

The following rules briefly indicate the course of treatment to be adopted in gunshot fractures of the upper extremity when the general circumstances are such as to admit of attempts being made to preserve the limb. When the bone is much splintered, make an examination by the finger for any foreign bodies or detached pieces of bone, and remove them; such partially-detached portions, and such fragments as are only retained by very slight and narrow periosteal connections, should also be removed; the sharp points of projecting spiculæ should be carefully sawn or cut off;[1] the wound being extended for this purpose at the most dependent opening if there are two wounds, or a fresh incision being made if only one exists, and it is not in a favorable position for the operation. Wetted lint, or carbolic-acid dressing, should then be applied, the limb properly supported, and the cure proceeded with as in cases of compound fracture from other causes (see FRACTURES, VOL. I.).

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[1] Bulletin de l'Académie Impériale de Médecine, April 24, 1860. See also Des Amputations consécutives à l'Ostéomyélite dans les Fractures des Membres par armes à feu, par M. H. Baron Larrey, Paris, 1860; and "Remarks upon Osteo-myelitis consequent on Gunshot Wounds of the Upper and Lower Extremities," by T. Longmore, in vol. xlviii. of the Medico-Chirurgical Transactions, London, 1865.

[1] Dupuytren made a division of the splinters of bones broken by gunshot into three classes: viz., primary sequestra, those directly and completely separated by the force of the projectile at the time of the original injury; secondary sequestra, those retaining partial connections by periosteal, muscular, or other attachments, but afterwards thrown off during the suppurative process; and tertiary sequestra, or portions which become necrosed, their death being either due to the

If the shoulder or elbow-joint be much injured, but the principal vessels and nerves have escaped, the articulating surfaces and broken portions should be excised. The results of excision practised in the shoulder and elbow-joints, especially the former, after gunshot wounds have been exceedingly satisfactory. Especial attention was first directed on any extensive scale to the practice of resections of these joints, after gunshot injuries, in the Schleswig-Holstein campaigns, between 1848 and 1851: and Dr. Friedrich Esmarch has published the results in a valuable essay on the subject. Of 19 patients in whom the shoulder-joint was resected, in 12 a more or less useful arm was preserved; and 7 died. Complete anchylosis did not occur in any one instance; and in several the power of motion became so great as to enable the men to perform heavy work. Of 40 patients for whom resection of the elbow-joint was performed, 6 died, 32 recovered with a more or less useful arm, 1 remained unhealed at the time Dr. Esmarch wrote (1851), and in 1 mortification ensued, and amputation was performed.

The cases of resections of joints in the upper extremity during the Crimean war, of which records have been preserved, are comparatively few in number, but the results of the operations were satisfactory. Out of thirteen resections of the shoulder in the English force between April 1, 1855, and the end of the war, there was only one death; eight of these were primary, five secondary operations. Out of 14 elbow-joint resections during the same period, there were three deaths. The returns of the resections in the French army are less favorable. Out of 45 resections of the shoulder recorded by Dr. Chenu, there were 25 deaths; of four resections of the elbow, all died. During the late war in New Zealand several resections of joints were performed[1] with remarkably successful results. Resection of the shoulder-joint was performed nine times, and of the elbow-joint twice, and no death occurred.

Resections appear from the Washington report before quoted to have been extensively practised during the late war in the United States. The returns are not yet complete, but they show with regard to the shoulder-joint, that the results have been ascertained in 210 primary, and in 298 secondary, resections. Among the 210 primary resections there were fifty deaths, or 23.8 per cent.; among the 298 secondary resections, 115 deaths, or 38.5 per cent. Thirty-six cases of gunshot fracture of the head of the humerus are stated to have been selected as favorable cases for the expectant plan, the treatment being carried out without resection or amputation. Of these sixteen died, or 54.4 per cent.

The results are reported in 286 cases of resections of the elbow-joint. Of these, 62 terminated fatally, or 21.67 per cent.; in sixteen cases secondary amputation of the arm became necessary. The compilers of the report anticipate that the percentage of mortality will prove to be less when the statistics of this operation are completed.

Thirty-five resections of the wrist-joint during the United States war are recorded. In 27 of these cases the end of either the radius or the ulna, or the ends

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effects of the original contusion, or to prolonged inflammatory action in parts adjoining the seat of fracture. In accordance with this arrangement, surgeons have usually regarded the removal by surgical interference of the primary and secondary sequestra as simply anticipating nature in her work; but it has been stated by some German surgeons as one result of the experience of the Schleswig-Holstein war, that in the majority of comminuted fractures, the removal of splinters retaining any connection whatever with periosteum is not only unnecessary, but often injurious; as is also the practice of sawing off the broken ends of bones projecting from comminuted parts. It is asserted that by proper treatment and under favorable circumstances, such splinters become impacted in the callus, assist in strengthening the new bone in process of formation, and in time unite with the other parts of the bone, so that in this manner a cure is completed without operative interference. No doubt this does happen in some cases, but it is a matter of constant observation also, and the writer believes in the majority of cases, that splinters which have thus become impacted in callus are subsequently discharged with tedious irritation, as if they were so many foreign bodies; and, again, that the removal of jagged ends of broken bones has been very valuable in preventing untoward accidents in their neighborhood, and thus of favoring union. It is for these reasons that English surgeons generally pursue the practice above recommended.

[1] For histories of the cases referred to, and observations on the condition of the patients after their arrival in England, see papers on the subject published by the writer in the Army Medical Reports, vol. v., p. 558, London, 1865, and vol. vi., p. 510, London, 1866.

of both, were removed, and in some instances shattered fragments of the upper row of carpal bones. In 8 cases the greater part of the carpus was excised. Twenty-six of these cases are reported to have recovered, 2 were followed by amputation, and 3 died. The result in the remaining 4 is not stated. It is remarked that the reports are unsatisfactory in relation to the amount of mobility left in the hand, but further investigations are promised on this point.

Gunshot wounds of the wrist-joint are usually attended with so much injury to the superficial structures that it seems scarcely possible their treatment by resection can ever under such circumstances produce satisfactory results. Just as extensive laceration of the forearm, by destroying the motor power, renders a hand useless, so does destruction of the functions of the flexor and extensor tendons by which the wrist-joint is embraced, effect the same result; and a hand that cannot be used is not simply useless, but is generally a painful encumbrance to the possessor. This does not apply to partial amputations, for even though only one or two fingers remain, so long as the power of flexion and extension is retained, they become most valuable: the preservation of a thumb and finger if possible is a most important object to attain. As a secondary operation, after rare exceptional cases of gunshot wounds of the wrist in which the superficial structures have escaped, there is no reason why resection of the wrist should not be attended with the same excellent results that have attended the operation when performed for conditions of disease.

[*Excision of the shoulder-joint.*—The records of the Surgeon-General's office at Washington give an aggregate of 1086 excisions of the shoulder-joint for shot injuries; 739 were of the Federal army, with a death-rate of 35.7, and 347 were of the Confederate army, with a death-rate of 39.4 per cent. Nearly two-fifths of the latter reports, however, were so incomplete as to make the ratio of no value.

In 876 excisions at the shoulder for shot injury, where the result as to fatality was determined, 515 were primary excisions, with a death-rate of 31.06 per cent.; 224 were intermediary operations, with a death-rate of 46.4 per cent.; and 92 were secondary operations, with a death-rate of 29.3 per cent. In the 876 excisions the aggregate mortality was 305, or 34.8 per cent.

The great fatality of excisions during the intermediary or inflammatory period is strikingly shown in the above record. The rule not to operate during this period except when the necessity is extreme, is applicable not only to injuries of this joint, but to all excisions and amputations. Secondary operations furnish the best record; but many cases requiring excision of the shoulder would die before this period was reached.

Amputation at the shoulder-joint.—852 cases of amputation at the shoulder-joint after shot-fractures are reported. In 25 of these cases the result is unknown. In the 827 determined cases 499 were primary amputations, with a mortality rate of 24.1 per cent.; 157 were intermediary, with a mortality rate of 45.8 per cent.; 66 were secondary, with a mortality rate of 28.7 per cent.; and 130 were amputations of unspecified date, with a mortality rate of 23.5 per cent. The mean death-rate of the whole number at all periods was 28.5 per cent.

Expectant plan of treatment.—577 cases of shot injury of the shoulder-joint were treated by expectancy, with a death-rate of 25.1 per cent.

Whole number treated.—Of the whole number of determined cases treated either by expectancy, excision, or amputation, there were 2369; 31.1 per cent. of this number were fatal.

A careful investigation of the cases tabulated and analyzed by Dr. Otis, shows the great importance of a thorough examination of all shot injuries of the shoulder before concluding upon the plan of treatment. The fact of the joint being opened by the missile, or the existence of simple fracture, does not necessarily warrant operative interference. All slight shot injuries of the shoulder-joint should be treated by expectancy. When the ball has lodged in the head of the bone, or the fracture is comminuted, and there is no lesion of the artery, vein, or nerves, excision should be performed. Amputation should be confined to cases where along with fracture, injury of the axillary vessels exists, or where serious injury has been done the limb lower down. Excision may be resorted to when there is concomitant fracture of the neck of the scapula or acromial end of the clavicle.

Except to save life in cases of hemorrhage, gangrene, or other imminent danger, intermediary amputations and excisions should not be practised.

Shot-fractures of the shaft of the humerus treated by expectation.—2960 cases of shot-fracture of the shaft of the humerus treated by expectant conservative measures, with results known, are reported in the Surgical History of the War, Part II., vol. ii., p. 666. 2509 were returned to duty or discharged, and 451 died; a mortality of 15.2 per cent. Dr. Otis observes that it is obvious that the least severe cases were selected for this plan of treatment.

Excisions in shaft of humerus.—696 cases of excision in the shaft of the humerus for shot injury are tabulated, with 477 recoveries, 191 deaths, and 28 undetermined cases; a mortality of 28.5. 487 of these cases were primary operations, with a mortality of 30.7 per cent.; 93 were intermediary, with a mortality of 31.1 per cent.; 41 were secondary, with a mortality of 12.1 per cent., and 75 in which the time of operation was unknown, with a mortality of 19.0. It appears from this statement that the secondary operations were the most favorable. It will be seen that the death-rate after excision of the shaft of the humerus is nearly double that found in the expectant plan of treatment. Moreover, in the 477 recoveries after excision, 164 cases terminated in "non-union," or "false joint;" and in 37 cases of reported recoveries, amputation was finally found necessary. The unfavorable results of excision in the continuity of the humerus in the American war, confirm the experience of European surgeons in the Crimean, Schleswig-Holstein, and Danish wars. When to the above is added the statement that the fatality following excision in the shaft of the humerus is 12 per cent. greater than the mortality of amputations of the upper third of the arm, the operation should be considered, at least, as rarely justifiable.

Amputations of the upper arm.—5273 cases of amputations of the upper arm in the continuity are reported, with a mean death-rate of 23.6 per cent.; 3259 were primary operations (within forty-eight hours), with a mortality of 18.4 per cent.; 902 were intermediary operations (from the third to the thirtieth day), with a death-rate of 33.4 per cent.; 411 were secondary amputations (performed after the thirtieth day), with a mortality of 27.7 per cent.

It is almost impossible to fix upon any definite rules by which the surgeon is to be guided in the treatment of shot-fractures of the arm. Every case is to be determined, as it were, for itself. Not only should the nature and extent of the injury and character of tissues involved be investigated, but the general health of the patient, his age, habits, temperament, the possible necessity of transporting him from the field hospital to one at a greater distance, etc., should all be considered in determining this question. When the arm is torn off and a ragged, lacerated end is left, amputation to obtain a good stump is necessary, and should be done as soon as the shock of injury has passed off. When the bone is badly comminuted, flesh torn away, bloodvessels ruptured, or joints opened, amputation to prevent gangrene is plainly the proper course to pursue. The value of the upper extremity is, however, so great that the surgeon is willing, if there is a good chance of saving the limb, to make the patient incur some increased risk of life, and prolonged suffering; and military surgeons of the largest experience are the strongest advocates for conservative surgery in shot-fractures of the arm. Amputation is not unavoidable in comminuted fracture of the shaft of the bone; nor does fracture of the bone with laceration of the brachial artery necessarily demand amputation of the limb.

In comparing the nearly 3000 shot-fractures of the shaft of the humerus, treated by expectancy, with the 5273 amputations of the arm, we find the death-rate of the former 15.2, and of the latter 23.6 per cent. It should be remembered, however, that the slightest cases principally were treated conservatively, and that many cases so treated at the beginning, were afterwards subjected to intermediary or secondary amputations, with increased mortality rates. If all the facts could be adduced, it would probably be found, as Dr. Otis states, that the conservative plan of treatment really exhibited a larger proportion of deaths than that which followed primary amputations.

Excision of the elbow-joint.—In the Surgical History of the War, Part II., vol. ii., p. 845, are recorded 626 partial and complete excisions of the elbow-joint, of which 470 recovered, 146 died, and in ten the result was unknown, a mortality of 23.7 per cent. Of these operations, 322 were primary, with 68 deaths and four unknown results; 197 were intermediary operations, with 69 deaths and one unknown; 54 were secondary operations, with five deaths; and 53 were operations of uncertain date, with four deaths, and five undetermined cases. The record indicates very clearly that the primary operations give the best results; and another important fact, that the more complete the excision the less the danger of life. The difference between the percentage of deaths after excision of the elbow, 23.7, and the percentage of deaths after amputation in the upper arm, 23.6, is only one-tenth of one per cent. From reports made by German surgeons in the Franco-German war (Surgical History of the War, Part II., vol. ii., p. 901), 183 excisions of the elbow for shot-fracture are recorded. Of these 135 recovered and 48 died, a percentage of mortality of 26.2.

In the same war, 1870–71, M. Chenu reports 212 excisions of the elbow, by French surgeons, of which 48 recovered and 164 died, a percentage of mortality of 77.3. It is difficult to account for this appalling record in French surgery.

Amputation at the elbow.—Thirty-nine determined cases of amputation at the elbow are reported, with three deaths, or

7.6 per cent. Five of the patients recovered, however, only after a second amputation—three in the upper arm and two at the shoulder-joint (Surgical History of the War, p. 909). In addition to the above, Surgeon Sorrell, C. S. A., reports seven cases of disarticulation at the elbow, in the Confederate States Hospital, with two deaths.

The stumps left after amputation at the elbow seemed, in several instances, to be badly suited for the use of artificial limbs.

Of shot-fractures of the forearm treated by expectation.—2943 determined cases are reported, with 191 deaths,—a mortality rate of 6.4 per cent.

Excision in the forearm for shot injury.—986 instances are reported, with 856 recoveries, and 109 fatal and 21 undetermined cases,—a death-rate of 11.2. In nearly all of the cases the excision was limited to a few inches of the shaft of one of the bones. The average usefulness of the hand after these excisions was unsatisfactory, but the fatality was less than that of amputation of the forearm. Excision in the continuity of the bones of the forearm should be reserved for very exceptional cases. When the hand can be saved the best plan of treatment is the expectant one; that is, loose pieces of bone are to be removed, the part put at rest, and inflammation combated.

Amputation of forearm.—In a record of almost 1700 amputations of the forearm for shot-injury, the death-rate was found in primary operations to be 9.6 per cent.; that of intermediary 23.5 per cent; and that of secondary, 15.7 per cent., showing the superiority of the primary operation.

Excision at the wrist-joint for shot-injury.—The records of the Surgeon-General's office give 96 excisions of the radio-carpal joint for shot-fractures; six were complete excisions of both rows of the carpal bones, with the distal end of the radius and ulna; and the remaining 90 were partial excisions. Fifteen cases ended in death, or 15.6 per cent., a slightly higher death-rate than that following amputation in the forearm for shot-injury. In the six complete excisions, one died; after recoveries in either complete or partial excision, the function of the hand was generally much impaired; 51 cases had anchylosis at the wrist, and five had motion but great deformity. Frequently "the hand was strongly deflexed to the radial side, often at right angles, and the fingers rigidly fixed in flexion or extension." In a few of the cases the result "was not altogether unsatisfactory."

The expectant and conservative plan of treatment is the one probably which offers the best chances of success in shot-wounds of the wrist, unless the fracture is very extensive and the joint disorganized.]

Lower extremity.—Gunshot wounds of the lower extremity vary much more greatly in the gravity of their results, as well as in the treatment to be adopted, according to the part of the limb injured, than happens in those of the upper extremity. As a general rule in field-practice, ordinary fractures below the knee, from rifle-balls, should never cause primary amputation; while excepting in certain special cases, in fractures above the knee, from rifle-balls, amputation is held by most military surgeons to be a necessary measure. The special cases are, gunshot fractures of the upper third of the femur, especially if it be doubtful whether the hip joint is implicated or not; for in these the danger attending amputation itself is so great, that the question is still open, whether the safety of the patient is best consulted by excision of the injured portion of the femur, by removal of detached fragments and trusting to natural efforts for union, or by resorting to amputation. The decision of the surgeon must generally rest upon the extent of injury to the surrounding structures, the condition of the patient, and other circumstances of each particular case. If the femoral artery and vein have been divided, any attempt to preserve the limb will certainly prove fatal.

The femur—the earliest formed, the longest, most powerful, and most compact in structure of all the long bones of the body—can only be shattered by a ball striking it with immense force. But this amount of force a modern rifle-ball possessses at all ordinary distances, and, unfortunately, in almost every instance of compound fracture of the femur by rifle projectiles, we find the bone not merely broken, but extensively comminuted at the seat of fracture, and often fissured for long distances along the shaft. When a patient with a gunshot fracture of the femur comes under a surgeon's charge, however free from complications and however favorable the case may appear to be, the surgeon knows that the patient will be unavoidably subjected to a wide variety of hazardous circumstances if an attempt to conserve the injured limb be determined upon, owing to the prolonged hospital treatment which is absolutely necessary before a cure can be completed. The treatment, too, is very difficult; for while, on the one hand, the most perfect rest, and as uninterrupted an apposition of the broken portions of bone as possible, are essential for obtaining reunion—on the other, the close connection of the broken bone with the trunk, and consequently the liability to disturbance in all movements of the body, with the necessity for the daily removal of the profuse discharges which follow these wounds, are so many constantly recurring impediments to procuring the quiet so essential.

A considerable amount of attention was specially directed during the Crimean war to the question of the proper treatment of gunshot fractures of the femur, and expectations were generally held that the advanced experience in conservative surgery would lead to many such cases terminating favorably with preservation of the limb, which previously would have been subjected to amputation. Towards the latter part of the campaign, all the circumstances of the patients were as favorable for testing this practice as they have been in the various revolutionary engagements in Paris. They had equally the advantages of immediate attention, and of all the appliances of the best hospitals close at hand. Yet, in the Surgical History of the War, it is shown that only 14 out of 174 cases of compound fracture of the femur among the men, and 5 out of 20 among the officers, recovered with union of bone, or in other words, without amputation being performed: that those selected for the experiment of preserving the limb were patients where the amount of injury done to the bone and soft parts was comparatively small; and that where recovery ensued, it always proved tedious, and the risks during a long course of treatment numerous and grave. Out of the 174 soldiers just mentioned, 96 were subjected to amputation, and, of the 78 in whom amputation was not practised, 64 died:—of the 20 officers, 10 were subjected to amputation, and, of the remaining 10 not operated upon, 5 died. Amputations of the thigh, however, were very fatal in their results also, the recoveries being stated to be among the men only 34.7 per cent. Among the officers the proportion was rather more favorable. But this percentage includes those cases in which previous attempts to preserve the limb had failed, and, death threatening, amputation was resorted to as a last chance of saving the patient. The number of deaths under the head of amputations was thus increased. On account of this comparatively indifferent success of amputation, resection of portions of the shaft of the femur was sometimes practised; but the records state that no success attended the experiment, every case, without exception, having proved fatal. It is therefore seen from the English experience in the Crimea of the treatment of gunshot fractures of the femur, that the hopes of conservative practice being the means of preventing amputation were not realized. Of the three modes of treatment, resection was the most fatal; conservative treatment, next; and amputation least fatal. The first was uniformly fatal; the deaths among cases treated without operation were 82 per cent.; the deaths among those treated by amputation, almost hopeless cases included, were 65.2 per cent.

In considering the results of gunshot fractures of the femur, the situation of the injury is a matter of great importance as regards the chances of recovery, whether without or with amputation. In the Official History of the Crimean Campaign, this fact is shown in the results of amputation, the recoveries in the upper third being 12.9, in the middle third 40, in the lower third 43.3 per cent. of the cases treated; but the distinction is not made in regard to the recoveries without amputation. Hence no exact numerical comparison can be drawn between the results of amputation and conservative practice in the three main divisions of the thigh in this instance. Dr. Macleod, in his Notes, remarks that he has only been able to discover three cases in which recovery followed a compound fracture in the upper third of the femur without amputation; one, that of an officer of the 17th Regiment; the second, of a soldier of the 62d; and a third, whose regiment is not named. A case, however, was under the care of the writer, not included in the above, nor appearing in the official history of the war; and one, judging from the results described in Dr. Macleod's Notes, more fortunate in its issue than at least two of the number he mentions. With regard to the first patient, Dr. Macleod states he has been informed "that although his limb was in a very good condition when he left for England, the trouble it has since given him, and the deformed condition in which it remains, make it by no means an agreeable appendage;"[1] in the second, the fracture was in the lower part of the upper third, and the injury was comparatively slight; in the third, a mass of callus was thrown out which connected the bone, but he died of purulent poisoning and never left the Crimea. In the case which was under the writer's care, the fracture was within the upper third; there is no distortion, and shortening only of 1¼ inches: the officer is able to walk or ride without any inconvenience, and competent for all duty.[2] All the circumstances were most favorable for recovery in this instance; and a consideration of these on the one hand, and the experience of the unfavorable results of amputation in this region on the other, led to the effort to save the limb. A short history of this case will be useful.

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[1] The officer referred to must have greatly improved in condition after Dr. Macleod wrote, as he was for some time afterwards on active service in India, though he is no longer in the army.

[2] This officer is at present holding an important staff-appointment in India.

Lieutenant D. M., 19th Regiment, æt. 17, of sanguine temperament, healthy frame, was brought up to camp about 4 A. M., Sept. 9, 1855. He had been wounded in the assault upon the Redan in the upper part of the left thigh, and had been lying by the side of the ditch where he fell thirteen hours. When discovered, he was carried carefully in a soldier's great-coat as far as the opening of the trenches, and thence on a stretcher to camp. He was very cold and prostrate on his arrival. The wound in his left thigh had been caused by a ball which had passed out. It entered posteriorly at the fold between the left nates and thigh, three inches from the tuberosity of the ischium; passed forwards, downwards, and outwards, and made its exit seven inches below the trochanter major. The femur was broken in the line of passage of the ball, which, from entrance to exit, appeared to be about six inches. From the trochanter major to the seat of fracture was four inches; to the external condyle on the same side was 15½ inches. The amount of comminution appeared slight, but, from its vicinity to the joint, the great swelling about the limb, and desire to avoid aggravating pain, the precise condition of fracture was not further ascertained. The upper fragment projected forwards, but any attempts at reduction caused great suffering; and some restoratives being given, wet compresses applied to the thigh, and the limb secured against additional movement, the patient was left to rest. At a consultation the following morning, from the patient's age, so favorable for reparative action, his very healthy constitution, and the fact that, the siege being over, full attention could be paid to the case, conservation of the limb was settled to be attempted, and the patient was therefore treated with this view. In addition to the wound just named, he had received an extensive contusion of the right thigh by the fall of some heavy substance from the explosion which occurred at 1 A. M., after the Russians left the Redan.

There is not space to follow the details of the treatment of this case. The cure was protracted by large and troublesome bedsores; and attention to these, to the discharges from the wound, and to preserving favorable position, occupied much time and care daily, and caused many changes in the appliances for these objects to be from time to time necessary. On November 4, union had so far taken place that he was able to raise his body from the knee upwards while in bed, without apparent motion at the seat of fracture. On November 15, in consequence of the great explosion at the right siege-train, he had to be carried to another division of the camp; this was effected without harm. In the middle of January he was able to sit in a chair without inconvenience; and on February 22, he left the Crimea for England, being able to walk with the assistance of crutches. Union was then firm; but a slight serous oozing continued from the wound of exit, and there was much stiffness of the ankle and knee-joints from the long-continued constrained position to which he had been subjected. In July, 1856, after his arrival in Ireland, indications of pus collecting manifested themselves at the wound of exit; and Professor Tufnell, on passing a bougie about seven inches in the course of the wound, evacuated a small abscess, and felt a piece of bone trying to make its way to the surface. This was subsequently removed, and, under Mr. Tufnell's able care, the stiffness of the joints gradually disappeared, and he was enabled to return to duty.[1]

Dr. Macleod says that, after many inquiries respecting cases of this nature in the hospitals of the other armies engaged in the war, excepting one presented by Baron Larrey to the Sociétié de Chirurgie in 1857, he never could hear of any other but that of a Russian, whose greatly shattered and deformed limb he often examined.[2] It had united almost without treatment. Six cases of recovery without amputation after fracture in the upper third of the femur came from India among 900 invalids for gunshot wounds consequent on the Sepoy mutiny. In 4 of these cases the patients had good useful limbs; in 2, the consolidation was not complete on the men leaving the invalid hospital, there still being some sequestra to come away from the seat of injury. The number of men who returned after amputation in the upper third was 3. So far as these data go, the proportion of recoveries after gunshot fracture in the upper third without operation was 1 in 150 of all classes of wounds, and that after amputation was 1 in 300. M. Jules Roux, of the St. Maudrier Hospital, at Toulon, has given a list of no less than twenty-one cases of recovery without amputation after gunshot injuries of the upper third of the femur, among the soldiers whom he had examined on their return from the Italian war of 1859. In all of them consolidation of the fracture had taken place. We have no data by which we can estimate the proportion of these cases of union to the recoveries after amputation in the same part of the femur.

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[1] The following is an interesting point in connection with this case, inasmuch as it illustrates how long a time a splinter of bone may remain impacted without causing irritation and then procure an outlet. The opening through which the sequestrum noticed above came away, became firmly healed after its removal. Although the officer has ever since been actively engaged in the duties of a cavalry officer, a great part of the time in tropical service, no symptom whatever occurred to indicate that any other sequestrum remained until the year 1866, ten years after the first was removed. Then some tenderness was felt, a small abscess followed, and another splinter of necrosed bone an inch in length escaped. The opening quickly closed, and its site has remained sound and free from any tenderness ever since.

[2] Notes on the Surgery of the Crimean War, p. 295.

In the war in the United States, out of 32 recorded cases in which amputation was performed in the upper third of the femur, 24 died, showing a mortality rate of 75 per cent.; out of 330 cases in which conservation was practised, 93 recovered, and 237 died, a mortality rate of 71.81, or a trifle more than 3 per cent. in favor of conservative measures. The various figures quoted above tend to confirm the propriety of the practice of conservation, which is generally recommended by military surgeons of the present day, in preference to amputation, for uncomplicated gunshot fractures of the upper third of the femur.

With regard to gunshot fractures in the middle and lower thirds of the femur, the experience of the French and English surgeons in the Crimea, and apparently of the surgeons engaged in the late war in the United States also, has tended to confirm the doctrine of the older military surgeons, that many lives are lost by trying to save limbs after injuries in these situations; and that, of the limbs preserved, many are little better than incumbrances to their possessors. In the Italian war of 1859, the practice of trying to save the lower extremities after comminuted fractures in the middle and lower thirds of the thigh appears to have been abandoned in consequence of the experience gained in the Crimea.

So far as the United States returns have gone, they do not show so much difference between the ratio of mortality when amputation is performed or conservation practised in these situations, as was generally deduced from the Crimean experience on this head. Out of 93 cases of fracture of the middle third in which amputation was performed, 42 recovered and 51 died, showing a rate of mortality of 54.83 per cent.; out of 238 cases in which conservation was practised, 106 recovered, 132 died, showing a mortality rate of 55.46 per cent. The ratios show, therefore, a slightly less fatal result when amputation was performed in the middle third, than when conservation was practised.

Out of 243 gunshot fractures of the lower third in which amputation was performed, 72 recovered and 101 died, showing a mortality rate of 57.79 per cent. Here the mortality rate was considerably less when amputation was performed, viz., as 46 to 57¾, than when conservation was practised. Experience so far, therefore, while indicating the propriety of practising conservation in the upper third, inculcates amputation to be the safest practice in gunshot fractures of the middle and lower third of the femur.

Amputation at the hip-joint, both in the French and English armies, in all instances proved fatal. The two patients who survived the longest in the English army were operated on by Mr. Alexander, afterwards Director-General of the Army Medical department, at the Alma: one, a soldier of the 33d Regiment, died at Scutari three weeks after the operation; the second, a Russian, died on the thirtieth day after, from "extensive sloughing and great debility."[1] M. Legouest, of the French army, performed amputation at the hip-joint in the case of a Russian prisoner, and the patient nearly recovered. He died the fourth month after the amputation, and then from the effects of a fall. In the Schleswig-Holstein campaigns, amputation at the hip-joint was performed seven times; one patient only survived, a young man, æt. 17 years, operated upon by Dr. Langenbeck. All the primary amputations at the hip-joint during the Italian war of 1859 proved fatal. A successful secondary case occurred at Verona, the operator being Dr. Neudörfer; and M. Jules Roux has recorded that amputation was performed at the hip-joint six times from the consequences of wounds received during the war in Italy, and that, of these, four were successful. During the late war in the United States there occurred 53 authenticated hip-joint amputations, 34 in the United States armies, 19 in the rebel armies. These have been divided in the history given of them into four categories; primary, intermediate, and secondary amputations, and re-amputations.[2] In the primary cases, 119 in number, the results of which are completely known, the mortality was 94.73 per cent.; in the intermediate, 18 in number, the mortality was 100 per cent.; in the secondary, 9 in number, 77.78 per cent.; in the re-amputations, 7 in number, only 42.85 per cent. M. Legouest, in an essay published in the Memoirs of the Society of Surgery, at Paris, maintains that amputation at the hip-joint should be reserved for cases of fracture with injury to the great vessels, and that where the vessels have escaped, resection should invariably be performed. He also inculcates the doctrine not to perform immediate *primary* amputation at the hip-joint in any case; but, even in the severest forms of injury, to postpone the operation as long as possible.[1]

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[1] In the surgical history of this war, this statement, which was quoted by the late Mr. Guthrie, in the addenda to his Commentaries, is said to be a mistake, on account of the absence (not to be wondered at, amid the confusion of that period) of official records on the subject. Special reports on these cases were obtained at the time from Scutari, and were shown to the writer by Director-General Alexander shortly before his decease.

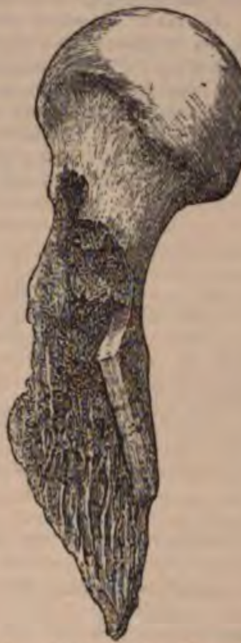
[2] Circular No. 7, W. D., Surgeon-General's Office, Washington, July 1, 1867. "A Report on Amputations at the Hip-joint in Military Surgery, by G. A. Otis, Assistant-Surgeon and Brevet Lieutenant-Colonel, U. S. Army." This report contains a very complete historical summary of the subject, as well as an account of the individual cases which occurred during the United States war. The report is beautifully illustrated by lithographic and chromo-lithographic drawings.

In fractures of the leg, where neither the knee nor ankle-joint are implicated, the results of conservative attempts have been more favorable. In the English army in the Crimea, the recoveries without amputation being resorted to were, in fractures of both bones, 18.9; tibia only, 36.3; fibula only, 40.9 per cent. When a gunshot fracture of the tibia extends into the knee or ankle-joint, opening the capsule, amputation is held to be the rule of treatment. In rare instances recovery without amputation has followed injuries where one or other of these joints has been believed to have been thus opened; but, when the interior of either of these articulations is penetrated under such circumstances, the risk to life in trying to preserve the limb must be very great, while the advantage of capacity for motion, if life be preserved, must always be doubtful. Conservative practice in such cases can only hold out a chance of success under the most careful and refined surgical treatment, with every means constantly at hand, as well surgical appliances as nursing, and under the most favorable sanitary conditions; combinations which the circumstances of warfare rarely allow.

In the treatment of fractures of the leg where it has been determined to seek union, the same remarks apply as those made above in respect to fractures in the upper extremity. In wounds of the foot it is especially necessary to remove as early as possible all the comminuted fragments of the bones injured; or tedious abscesses, and much pain and constitutional irritation are likely to ensue.

One case of excision of the head, neck, and trochanters of the femur for gunshot injury in the Crimea recovered. Fatal results followed five other cases in which similar excisions were practised by English surgeons during this war, as they had in all previous excisions of the hip-joint for gunshot injuries. The successful operation was performed on August 19, 1855, by Dr. O'Leary, the same day that the wound was received. The patient died ten years afterwards of phthisis. He never regained the power of using the limb without support, but required the aid of a crutch and stick to enable him to walk. In the Schleswig-Holstein cam-

Fig. 770.



Head, neck, and part of shaft of femur, forming the upper fragment in the case for which Mr. Guthrie successfully amputated at the hip-joint after the battle of Waterloo.[1]

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[1] A committee was appointed by the Surgical Society of Paris to examine and report upon this essay of Dr. Legouest on "Coxo-femoral Disarticulation for Gunshot Wounds." Baron Larrey drew up the report, which will be found in the 5th vol. of the Mémoires de la Société de Chirurgie, 1860. It confirms the principle laid down by Dr. Legouest, excepting only those cases of fracture where the mutilation of the limb from a heavy projectile has been so great as to partly separate it from the pelvis, and those in which there has been simultaneous lesion of the crural vessels and femur near the pelvis, with extensive laceration of the surrounding tissues.

Dr. Otis concludes that the experience acquired in the war of the Rebellion in the United States indicates that these maxims and rules are too unqualified and absolute.

[1] Spec. No. 2929, in the Army Medical Museum, at Netley.

paign a similar operation was performed three weeks after the injury, but the patient died from pyæmia. Dr. Neudörfer excised the hip-joint four times for gunshot injuries after the Italian campaign of 1859. The operation was not successful in any one instance. Three of the patients died, the fourth survived, but only after secondary amputation at the hip-joint. The results of hip-joint excisions in the United States have been more successful. Out of 31 such excisions, 4 have recovered, leaving 27 which have terminated fatally.

It is a curious fact, in a historical point of view, that Sir Charles Bell proposed excision of the upper fragment in 1818 at Brussels in the case of François de Gay, who had been wounded nineteen days before at Waterloo, and on whom Mr. Guthrie successfully practised amputation at the hip-joint the next day instead. The reasons for his advice are preserved in some manuscript notes made about the time of the occurrence, in a diary presented to the Army Medical School by Lady Bell, his widow. The chief points are the following: "My proposal is to extract the head of the bone, and do no more. Mr. Guthrie's proposal is to amputate the thigh at the hip-joint. If the bone be taken out, there is a great cavity and suppuration certainly; but by this means the shock and violence will be saved. I fear the shock of so great an injury, especially as now the wound cannot be cut off (alluding to its extent and sloughy condition) and its injury must be superadded to that of the incisions. The man will readily allow of my proposal, but not of G.'s. However, next day he said he would consent. In the mean time I was forced home by business," etc. The broken and separated head and neck of the femur in Guthrie's case is preserved in the Museum of the Army Medical Department at Netley, and, both from its intrinsic interest, and because it almost exactly corresponds with the upper fragment in the Crimean case in which resection was successfully performed, a drawing of it is appended. [Fig. 770, p. 513.]

[A comparison between hip-joint amputations and excisions for gunshot fracture of the head and neck of the femur can be made in the following tables, taken from Circular No. 2, Surgeon-General's Office, pp. 112 and 137. The first table gives the results of 115 cases of amputations at the hip-joint for gunshot injury from various campaigns prior to 1862. Sixty-two cases belong to the American war, and six cases have more recently been recorded.

Of the cases of excision 12 were recorded before, 63 during, and 10 since the American war.

Amputation.

	No.	Died.	Recovered.	Doubtful.	Death-rate.
Primary	79	75	1	3	98.68
Intermediary	76	70	6	...	92.10
Secondary	20	13	7	. .	65.00
Reamputation	8	4	4	...	50.00
Total	183	162	18	3	90.00

Excision.

	No.	Died.	Recovered.	Death-rate.
Primary	39	36	3	92.3
Intermediary	33	30	3	90.9
Secondary	13	11	2	84.6
Total	85	77	8	90.6

Dr. Otis says that experience has established the following rules: Amputation should be performed, 1st, when the thigh is torn off, or the upper extremity of the femur comminuted with great laceration of soft parts; 2d, when fracture is complicated with wound of the femoral vessels; 3d, when gunshot fracture of the hip-joint is complicated with compound fracture lower down, or by wound of the knee-joint.

There are two other contingencies requiring amputations, according to Dr. Otis, not, however, yet determined by experience: 1st, when, without fracture, the femoral artery and vein are divided near the crural arch; 2d, when fracture in the region of the trochanters is complicated by such extensive longitudinal fissuring as to make excision impracticable.

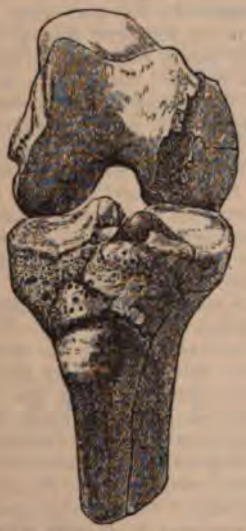
Secondary amputations and re-amputations are called for when caries or necrosis follow gunshot wounds of the hip, or amputations in the continuity.

Primary excision of the head and upper extremity of the femur should be practised when fracture of the articulation is uncomplicated. When diagnosis of direct injury of the joint is undoubted the expectant plan of treatment is to be condemned.

When diagnosis of gunshot injuries near the joint is uncertain, an incision should be made so as to permit a thorough exploration of the part. In a prize essay on Resection of Joints, in the Transactions of the American Medical Association, 1876, Dr. Culbertson has collected from different sources 121 cases of excision of the hip-joint for gunshot wounds, with a death-rate of 89.07 per cent.]

Direct gunshot wounds of the *knee-joint* are of the most hazardous nature. The admission of air by a tunnelled and contused track into so large and convoluted a synovial sac as that which lines the interior of this important articulation, and the subsequent effects of the inflammatory action induced by the injury, constitute their chief serious features when simple penetration of the joint has occurred. But penetration, or perforation, by a bullet rarely occurs without serious concomitant injury to the cartilaginous and bony structures which are comprised in this complicated articulation. The extent of the mischief which may be effected by a bullet entering the knee-joint, even when not possessing force enough to pass through the articulation, is well shown in the preceding drawing (Fig. 771).

Fig. 771.



Upper end of tibia, and lower extremity of femur, shattered by a bullet which has entered the joint, and become lodged near the spinous process of the articular surface of the tibia.[1]

Although this joint is so little covered by soft tissues, and consequently so easy of access, mistakes in diagnosis frequently occur in wounds of it by small projectiles, especially when the injuries have not been examined soon after their infliction. Deflection and escape of bullets, circuitous courses pursued by them, escape of fluid from the bursa beneath the ligamentum patellæ, have led to the supposition of the interior of the joint having been opened when no penetration has occurred; and equally in other cases, the joint has been presumed to have escaped penetration, until symptoms arising subsequently have exposed the error.

The proper treatment of a penetrating gunshot wound of the knee-joint, when the diagnosis has been satisfactorily established, is generally a matter of serious doubt and difficulty. The necessity of amputation, when the articulating ends of either or of both of the two principal bones are broken in addition to the joint being penetrated, has hitherto been generally recognized and acted upon in field practice. But the ratio of mortality in amputations at the lower third of the thigh, has frequently led surgeons to resort to other modes of treatment. Resection has been tried, but with comparatively little success, in field practice. It failed altogether in the Schleswig-Holstein campaigns, and in the Crimea. Three cases out of eight operated upon by Dr. Neudörfer, of the Austrian army, during the Italian war of 1859, recovered. Out of eleven resections during the United States war, the Surgeon-General's report states, all but two terminated fatally, and in one of these a doubt is expressed in the report as to its authenticity. Disarticulation of the leg at the knee was frequently employed by surgeons of the French army in the Crimea, in gunshot wounds involving the joint, when the femur had escaped injury. Out of sixty-nine cases of knee-joint amputation, however, only six survived. There were only seven instances of this operation in the British army, but out of these three recovered. Freely incising the joint has been tried, but has been only occasionally attended with success; one case treated in this way, in the late New Zealand war, recovered. A series of cases of gunshot wounds of the knee were similarly treated by Surgeon J.

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[1] Spec. No. 1481, in the Army Med. Museum at Washington.

Moses, of the United States army.[1] The official report, from the Surgeon-General's Office, gives no encouragement to practise this treatment. It refers to six fatal cases, which had been treated by free incisions by Surgeons Moses, Bellaugee, and Lidell, and mentions that the records contain a score of similar examples. Professor Langenbeck strongly advocates conservative treatment of gunshot wounds of the knee. There is hardly a case, he says, although with fractured bone-ends, that may not be cured by conservative treatment. Amputation, or resection, he reserves for cases where fragments of bone are actually severed, or where shattering of the bone-ends is complicated with considerable tearing or loss of soft parts. He considers it of the highest importance for success that the joint should be rendered immovable by rigid plaster-of-Paris bandages from the moment of injury to the completion of cure. Ice for the first three or four days, then lint dressings dipped in permanganate of potash, or carbolic acid, are the other applications recommended by him. During the Bohemian war of 1866, out of eighteen cases of gunshot wounds of the knee, eleven were cured by conservative treatment. Dr. Langenbeck mentions that the experience of that war has shown that men suffering from these wounds can be transported by railway with proper appliances without any ill results.

[Dr. Culbertson, in his prize essay (Trans. American Medical Association, 1876), has collected the records of 61 excisions of the knee-joint for gunshot injuries. Of these 15 recovered, 45 died, and in one case the result was unknown.

The rate of mortality after excisions of the knee for shot-fracture of the joint during the late American war, would be greatly increased if all the cases were reported. The writer saw six cases of this operation after the battle at Spottsylvania Court House, May, 1864. They were left with others in a hospital near the battle-field in charge of Surgeon Bushrod Taylor. All of them died—three before the end of the third day. In two of the cases intermediary-amputations were performed, and the sixth died from exhaustion during the third week.

The treatment of shot-fracture of the knee, on the battle-field at least, should be reduced to the choice between amputation and the conservative plan of treatment with immobilization and antiseptic measures.

When amputation is selected it should be done, if the end of the femur is uninjured, through the knee-joint, as the death-rate after this operation is much less than that attending amputations in the lower third of the thigh.

In 132 amputations through the knee-joint, by American surgeons, for gunshot injuries, 52 recovered; 49 of these cases were primary operations, with 31 recoveries, a death-rate of 36.7 per cent. It is difficult to account for the want of success in disarticulation of the knee by the French surgeons in the Crimea.

Gunshot fracture of the upper tibio-fibular joint is sometimes a grave injury, as the synovial membrane lining this articulation is often continuous with that of the knee. I have seen death follow in two cases of this character. One was a colonel of artillery, C. S. A., wounded at Fredericksburg. Under the expectant plan of treatment, inflammation extended to the knee, and death from its subsequent effects ensued.]

Gunshot wounds of the *ankle-joint* were also, until a comparatively recent date, held by all military surgeons to involve the necessity either of removal of the foot at the joint or of amputation above it, according to the extent of the injury. Resection of this joint was not considered an operation suitable for military practice. The aggravation of the original injury from the effects of transport from the field to successive hospitals; the tedious process of repair in case of resection being practised; the unceasing and minute attention required during the treatment; the many hazards to the patient during its course; the nature and disposition of the structures surrounding the articulation; the great uncertainty regarding the ulterior results of this plan of treatment, when circumstances might admit of the necessary care and attention being given; all these considerations led military surgeons to resort to amputation as the most advisable proceeding, both with regard to the safety of the patient's life and to his subsequent condition in regard to power of progression. There was no case of resection of the ankle-joint, properly so called, in either the English or French armies during the Crimean war. Professor Langenbeck, however, has practised resection of the ankle-joint in cases of gunshot injuries with remarkable success, and has done much to introduce it as one of the regular operations of military surgery in future wars. This distinguished surgeon, indeed, considers that resection of the ankle-joint ought to be as much practised as resection of the shoulder-joint, and that amputation ought only to be resorted to when the soft parts have been very largely lacerated, or when the arteries and nerves have been torn away. Professor Langenbeck practised resection of the ankle-joint in five cases for gunshot wounds sustained in the German-Danish war of 1864. Only one death occurred among them, and this was from hospital gangrene. All the resections were done sub-periosteally. Fixation was obtained by the immediate application of fenestrated gypsum bandaging. In one of these cases, in which a bullet entered at the internal malleolus and made exit at the external malleolus, notwithstanding altogether two inches and a half of the articulating portions of the tibia and fibula and astragalus were removed, the patient recovered with anchylosis, but *without any shortening*, owing to the extensive formation of new bone. In the late Bohemian war of 1866 Dr. Langenbeck performed eleven sub-periosteal resections of the ankle-joint, and out of these nine recovered with conservation of a useful foot. All the operations in these cases were secondary. With regard to the war in the United States, the Surgeon-General records, in the before quoted circular No. 6, that there were eight excisions of the tibio-tarsal articulation, and that of this number five died, and the conclusion put forth with regard to ankle-joint wounds is, that "the formal excisions are rarely successful." Dr. Langenbeck strongly insists on complete immobilization of the parts involved in the operation being indispensable for a successful result. It is not stated whether this formed part of the treatment adopted in the United States war.

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[1] See Amer. Journal of the Med. Sciences, vol. 47, p. 324.

[Dr. Culbertson has collected 45 cases of excision of the tibio-tarsal articulation. Thirty-two recovered, and twelve died. Complete immobilization and sub-periosteal resection were not adopted by the American surgeons in this operation.]

AMPUTATION.

It is not necessary to refer at much length to the question which was formerly disputed upon, the advantages of *primary* as compared with *secondary* amputation in gunshot wounds; for military surgeons, whether acting at sea or on land, have practically determined the subject. For a long time the directions of John Hunter, that amputation should not be performed until the first inflammation was over, based on the argument that the "amputation is a violence superadded to the injury, and therefore heightens the danger," and that this danger is aggravated in the instance of a man laboring under mental agitation, as on the field of battle, had great weight among English surgeons; but experience has led to a different practice. The greater success of primary amputation appears to be attributable to the facts that a contused and mangled limb is a constant source of accumulating irritation; that the exciting circumstances connected with battle lead a man to bear with courage at an early stage what subsequent suffering and anxiety may make him less willing to submit to; that a soldier, when first wounded, is most probably in stronger health than he will be after hospital restraint and confinement; that though the amputation is a violence, it is one the patient is likely to submit to with resignation, knowing that it is performed to remove parts which, if unremoved, will destroy life; and lastly, because the operation takes away a source of dread which must weigh down the sufferer so long as it is impending. The present practice has resulted from testing both modes of amputation. Mr. Guthrie showed, from the experience of the Peninsular war, that the loss in secondary amputation had constantly exceeded that from primary amputations in both the upper and lower extremities. More recent observations in both English and French campaigns have confirmed this result. M. Scrive records that the experience of the French army in the Crimea showed that the success of primary amputation sometimes exceeded by two-thirds that of secondary amputation. He excepts amputation at the hip-joint, and cites, as his reason for this exception, that in nine cases where the hip-joint amputation was performed primarily, death followed the operation a few instants or a few hours afterwards; while in three cases which he witnessed, where the amputation was consecutive, one lived five, another twelve, and the third twenty days. In respect to the particular time at which primary amputation is to be performed, the general practice of the present day is, when the operation is inevitable, to perform it as soon as it can be done, provided the more intense effects of "shock," where it has supervened on the injury, have passed off; and this practice generally accords with the feelings of soldiers, who not unfrequently press the surgeon for an early turn in being relieved from the suffering resulting from a shattered limb. In the cases where primary amputation is to be performed, a further reason given by M. Scrive for the operation being done on the same day that the wound is received is, that chloroform [or ether] acts then so much more benignantly and readily; while, on the following day, or day after, traumatic excitement becomes very energetic, and considerable resistance is afforded to its influence by wounded men, and longer time and a much larger dose of the chloroform are required to produce a state of anæsthesia. If only a moderate amount of "shock" exist, this does not appear to be a sufficient reason for delaying amputation; for a moderate exhibition of stimulus, and a few consolatory words, will generally remove this; and even though some faintness, pallor, and depression remain, no ill consequences ensue. Indeed, in the Crimea, primary amputations were repeatedly performed where shock had not wholly disappeared, and no harm resulted from the practice. The introduction of chloroform, by its negative operation of preventing pain or alarm, and by its positive action as a stimulus, has done much to remove many of the objections which were urged by John Hunter against early amputations after gunshot wounds. If collapse be intense, more than is accounted for by the wound to the extremity, suspicion will be excited that some internal injury has been also inflicted, and delay will be necessary for further observation of the patient. When active operations are proceeding, and it is necessary to carry the wounded to any distance, the advantages of early removal of shattered limbs are obvious, especially when means of rendering the limbs immovable during the transport are defective, or the transport itself has to be conducted over rough roads or in unsuitable vehicles, and the hopes of success from conservative treatment are thereby reduced almost to zero.

SECONDARY HEMORRHAGE.

Army surgeons meet in practice with secondary more frequently than primary hemorrhage in gunshot wounds. It may arise in several ways. Sometimes it results from the coagulum being forced out of an artery in which hemorrhage had previously been spontaneously averted by the ordinary natural process, this accident being consequent upon muscular exertion or increased impulse of the circulating system from any cause. This occurrence in the bottom of a deep wound will be often found to be a very troublesome complication. Sometimes an artery, which did not appear to be injured in the first instance, ulcerates or sloughs; or, without direct injury, a vessel may become involved in unhealthy deterioration of the wound, and give way; or in a granulating wound general capillary hemorrhage may be excited by stimulus of any kind, such as venereal excitement or excess in drinking; or the coats of the vessel may ulcerate under pressure from a detached fragment of bone or from some foreign body; or the artery may be accidentally penetrated by the end of a sharp spiculum. Secondary hemorrhage has been said to arise from increased arterial action, from the first to the fifth day; from sloughing, the effects of contusion, from the fifth to the tenth; from ulceration, to any more distant date.

If we could compare all the cases of hemorrhage which occur, secondary would, perhaps, statistically appear less dangerous than primary hemorrhage; for the latter, when happening from large vessels, must be very generally fatal, while, when hemorrhage occurs in them secondarily, the collateral branches have become partially adapted to the interruption of the flow of blood through the regular channel. Moreover, the larger arteries, when once filled with coagula and well contracted, fortunately do not frequently yield to the impulse which serves to produce secondary hemorrhage in vessels of smaller calibre.

The rule of treatment holds good in secondary as in primary hemorrhage—the bleeding vessel must be secured at the wounded part whenever practicable, and it must be tied both above and below the line of division, taking care to ascertain that the spot where each ligature is applied is sound. Hemorrhage from general oozing, from sloughing, and other causes, must be treated on the general principles applicable in all such cases. (HEMORRHAGE, Vol. I.)

WOUNDS OF NERVES.

Temporary paralysis from indirect contusion of nerves during the passage of a projectile is not unfrequent. Complete loss of power of motion and sensibility occasionally follows gunshot injuries, and generally indicates direct stroke, perhaps complete division, of nerves. After a time there may remain only modified deprivation of sensibility, partial loss of muscular force, and diminished power of resisting cold, with or without pain; and these symptoms may either be the result of contusion, together with the effects, perhaps, of inflammatory action, or of partial division. Atrophy of tissues and contractions of muscles are common remote results of injuries to nerves from gunshot, and often lead to soldiers being disabled for further service. Occasionally, after severe injuries, the functions of sensation and power of motion gradually but slowly return, in some instances with ultimate perfect cure, but mostly with a certain amount of impaired power of resisting rapid alternations of temperature, especially cold.[1]

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[1] During the war in the United States, under orders from Surgeon-General, Dr. Hammond, in the year 1863, a number of patients, laboring under gunshot wounds and injuries of nerves, were collected and treated in a

When a foreign body is lodged in or among nerves, it may induce tetanic symptoms of a fatal character, or great irritation and intense pain may result; and unless the source of these latter symptoms can be found and removed, if in a large nervous trunk of one of the extremities, they will sometimes lead to the necessity of amputation. The gunshot injuries which cause division of large nerves are usually attended with so much destruction of other parts, that the question of amputation has scarcely ever to be considered in reference to lesions of nerves alone.

TETANUS.

One cause of fatal termination in gunshot wounds is tetanus. It is generally believed that the proportion of deaths from this source is greater after actions in tropical climates, and that exposure to the night air in such regions has some special effect in producing them. The most common cause appears to be, however, the local injury to nerves, already mentioned, producing irritation along their course, and so leading to some morbid condition of the ganglionic portions of the motor tracts of the spinal cord. In the Crimean campaign, the proportion of tetanus was remarkably small as compared with former wars, being, according to the returns, only 0.2 per cent. of the number wounded. M. Scrive records that not more than thirty cases of tetanus occurred among the French wounded during the whole Crimean war, and this would show a somewhat less ratio even than in the British army. Dr. Stromeyer records only six cases of tetanus among 2000 wounded in the campaign of 1849 against the Danes. Three of these, in which the disease assumed a chronic form, recovered. Warm baths and opium were the remedies in the successful cases. Three hundred and sixty-three cases of tetanus were reported during the war in the United States, and of these the Surgeon-General's report states 336 terminated fatally. Of the 27 recoveries, the disease was of a chronic form in 23. In the four remaining cases, the symptoms were very grave; in two of them recovery took place under the use of opiates and stimulants; in the other two, after amputation of the wounded parts.

Three cases of tetanus occurred to the writer, in the Crimea, after gunshot wounds: all proved fatal. In one there was a severe fracture of the ischium and injury of testicle by grapeshot. In a second, a rifle-ball entered just above the left knee, and lodged. Eight days after the injury, an abscess was opened near the tuberosity of the ischium, and the ball was removed from that spot. The same day tetanus set in, and the patient died three days afterwards. The ball had injured the sciatic nerve, which was found to be reddened superficially, while the neurilemma also, under an ordinary magnifying-glass, showed indications of inflammation. A piece of cloth was found lying midway in the long sinus-like wound made by the ball. In a third, the bullet passed through the axillary region. The patient progressed favorably for some days, when tetanic symptoms appeared, and under these he sank. At the post-mortem examination, some detached pieces of woollen cloth were found lying entangled among the axillary plexus of nerves. Twenty-one cases altogether supervening on gunshot injuries are shown in a table in the Crimean records. Of these, ascertained injuries to nerves by projectiles, or divisions of nerves by amputation, occurred in eleven cases; three followed compound fractures, and seven flesh-wounds. The average period at which the tetanic symptoms appeared was eight days and a half after the receipt of the injury; their duration prior to death, three days and a half. One case only recovered: a soldier of the 93d Regiment, wounded in the right buttock by a shell-explosion. A fragment nearly a pound in weight was removed soon after the injury. Seventeen days after, trismus set in, when a further examination of the wound led to the discovery of an angular fragment of shell which had been previously overlooked. It was deeply lodged, and resting on the sciatic nerve. On removing this, which weighed eighteen ounces, the sheath of the nerve was seen to be lacerated to nearly one inch in extent. Calomel and opium were now given, salivation appeared three days afterwards, the trismus subsided, and the man gradually convalesced.

Beyond the extraction of any foreign bodies which may have lodged, as in this last case, it is not known that there are any indications for special treatment of tetanus as occurring after gunshot injuries. The employment of woorali has again been brought into notice by its successful administration by M. Vella, of Turin, in the case of a French sergeant

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special hospital in Philadelphia. These patients are described as having included representatives of every conceivable form of nerve injury, from shot and shells, sabre cuts, contusions, and dislocations. The results of the observations at this hospital have been published in a small volume, entitled Gunshot Wounds and other Injuries of Nerves, by S. W. Mitchell, M.D., G. R. Morehouse, M.D., and W. W. Keen, M.D.; Philadelphia: Lippincott & Co., 1864.

wounded by a musket-ball which lodged in the metatarsus of the right foot, on the 4th of June, 1859, at the battle of Magenta. The projectile was extracted three days after his admission into hospital at Turin, on June 10, and tetanus set in three days afterwards. But the woorali failed in two other cases; and it is as yet to be determined, should it be found to possess any peculiar power over tetanic spasm, to what class of cases its properties are applicable. The Surgeon-General's report, before quoted, states that its value as a curative agent was not tested in the cases of tetanus which occurred in the United States during the war. (See TETANUS, Vol. I.)

HOSPITAL GANGRENE, a common disease of wounded soldiers, when circumstances of war lead to over-crowding in ill-ventilated buildings, and to deficiency in the proper number of attendants for securing personal cleanliness and purity of atmosphere, often associated with inferior diet; and PYÆMIA, a frequent cause of fatal termination after gunshot fractures, injuries of joints, and other suppurating wounds, especially under the influence of circumstances like those above named, are treated separately under their respective heads.

ANÆSTHESIA IN GUNSHOT WOUNDS.

The complete applicability of chloroform as an anæsthetic to injuries caused by gunshot is now generally established. Ether is still believed by many surgeons in the United States to be more free from danger than chloroform. It is stated in the Surgeon-General's report that the returns of 23,260 surgical operations, performed on the field or in general hospitals during the late civil war, showed that chloroform was used in 60 per cent., ether in 30 per cent., and a mixture of the two in 10 per cent.; and further, that at the general hospitals, the greater safety of ether as an anæsthetic was commonly conceded.[1]

The first opportunity of testing chloroform largely as an anæsthetic agent in military surgery occurred in the Crimean war, and a long report on the subject will be found in the Official Medical and Surgical History of the Campaign. The general tenor of this report is to curtail the use of chloroform—in minor operations on the ground of occasional bad results, even when the drug is of good quality and properly administered, or, in cases where the shock is very severe, on the ground that such do not rally, owing to the depressing effect of the drug, after the anæsthesia has gone off; or, in secondary operations, from the systems of the patients having been much reduced by purulent discharges. But from the report it appears that only one patient died from the effects of chloroform, and in this instance Professor Maclagan, of Edinburgh, to whom a portion was forwarded for examination, reported the drug to be "acrid and nauseous when inhaled," and "totally unfit for use." On the other hand, M. Scrive, chief of the French Medical Department in the East, has written in his Relation médico-chirurgicale de la Campagne d'Orient, p. 465: "De tous les moyens thérapeutiques employés par l'art chirurgical, aucun n'a été aussi efficace et n'a réussi avec un succès aussi complet que le chloroforme; jamais, dans aucune circonstance, son maniement sur des milliers de blessés n'a causé le moindre accident sérieux;" and more recently, Surgeon-Major M. Armand has written: "During the Italian war chloroform was as extensively used, and was as harmless, as in the Crimea. I never heard of an accident from its use." During the late civil war in the United States seven deaths were ascribed to the use of chloroform; at the same time the Surgeon-General's report mentions that the returns indicate it was administered in not less than 80,000 cases.[1]

At the commencement of the Crimean war the Inspector-General at the head of the British Medical Department circulated a memorandum "cautioning medical officers against the use of chloroform in the severe shock of serious gunshot wounds;" but as far as chloroform was available, it was used by many medical officers from the commencement of the campaign, and its employment became more general as the campaign advanced. It was constantly used in the division to which the writer belonged throughout the war, and no harm was ever noticed from its use, while certain advantages appeared especially to fit it for military surgical practice. So far from adding to the shock of such cases as an army surgeon would select for operation, the use of chloroform seemed to support the patient during the ordeal; and the writer has several times seen soldiers within a brief period after amputation for extensive gunshot wounds, and restoration to consciousness, calmly subside into natural and refreshing sleep. One reason for not using chloroform in the Inspector-General's caution was, that the smart of the knife is a powerful stimulant; but "pain," it has been remarked by a great

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[1] Circular No. 6, p. 87.

[1] Circular No. 6, p. 87, where brief abstract reports of the seven fatal cases above referred to may be found.

PART V.

OPERATIVE AND MINOR SURGERY.

ANÆSTHETICS.
AMPUTATION.
[OPERATIONS ON ARTERIES.
VARIOUS OPERATIONS.]
PLASTIC SURGERY.
MINOR SURGERY.

PART V.

PERATIVE AND MINOR SURGERY.

ANÆSTHETICS.
AMPUTATION.
[OPERATIONS ON ARTERIES.
VARIOUS OPERATIONS.]
PLASTIC SURGERY.
MINOR SURGERY.

PART V.

OPERATIVE AND MINOR SURGERY.

ANÆSTHETICS.[1]

By Joseph Lister, Esq.

Revised by J. C. Reeve, M.D.

To prevent or diminish pain in surgical operations is an object so desirable, that many in various ages in the history of Medicine have sought to attain it, either by means of narcotic drugs designed to act on the body generally, or by compressing or otherwise locally affecting the nerves of the part concerned.[2]

The first really valuable suggestion, however, was made in the year 1800, by Sir Humphry Davy, who, having himself experienced relief from pain when breathing nitrous oxide gas, threw out the hint that it might probably be employed with advantage to produce a similar effect in surgical practice.[3]

The same idea occurred, after the lapse of nearly half a century, to Dr. Horace Wells, a dentist in Hartford, Connecticut, who, in 1844, underwent the extraction of a tooth without pain after inhaling the gas, and gave it with satisfactory results to several of his patients; but he soon after found the practice so uncertain that he abandoned it entirely.[4]

About the same period, Dr. W. T. G. Morton, of Boston, in America, who had previously been a partner with Wells, but did not, as he informs us, receive any suggestion from him, became possessed with the desire of discovering an efficient anæsthetic, and commenced a series of experiments upon himself and the lower animals, which at last resulted in his extracting a tooth painlessly from a patient, to whom he had administered the vapor of sulphuric ether by inhalation. This was on September 30th, 1846.[1] Soon afterwards he publicly exhibited his method at the Massachusetts General Hospital; and thenceforward anæsthesia in surgery was an established blessing to mankind.

Sulphuric ether is still extensively used as an anæsthetic in America; but in Europe chloroform is generally preferred to it. Disguised under the name "chloric ether," in which it exists diluted with spirit of wine, this agent was the subject of Dr. Morton's first experiment upon himself;[2] and it was used in the same form at St. Bartholomew's Hospital, in preference to sulphuric ether, by Mr. Lawrence in the summer of 1847.[3] In the autumn of that year, Dr., afterwards Sir James Y. Simpson, who was engaged in a series of experiments with various narcotic vapors, employed for the first time the active principle of chloric ether, at the suggestion of Mr. Waldie, of the Apothecaries' Hall, of Liverpool;[4] and finding that the pure chloroform was more potent than sulphuric ether, yet caused less bronchial irritation, while its odor was more agreeable, and its inferior volatility rendered its exhibition more easy,[1] he zealously recommended it to the profession, and it has since been generally employed throughout Europe.

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[1] In revising this article for the 2d edition, I have thought it best to leave it essentially unchanged, and append to it such observations as have been suggested by the experience of the time which has elapsed since the first publication. See p. 533.

[2] For much curious information regarding the history of this subject the reader is referred to the work of the late Dr. Snow on Anæsthetics.

[3] Chemical Researches, p. 556.

[4] Statements of William T. G. Morton, M.D., on his claim to the Discovery of the Anæsthetic Properties of Ether, etc., Washington, 1853, p. 42, etc.

[1] Dr. Morton's Statements, etc., p. 45, etc.

[2] Op. cit., pp. 45, 46.

[3] Snow on Anæsthetics, p. 20. That chloric ether was employed at St. Bartholomew's Hospital has been further confirmed by information kindly communicated to me by Mr. Paget.

[4] Snow on Anæsthetics, pp. 21, 22; also Dr. Simpson's original pamphlet, Account of a new Anæsthetic Agent, etc., p. 6.

The effects produced by chloroform are such as to fit it remarkably for the purposes of the surgeon. Like most narcotics, it tends to cause, after temporary excitement, suspension of the functions of the nervous centres, but affects them not simultaneously, but in a certain order; and the brain is the first to show loss of power, in failure of sensation and voluntary motion. If this were all, anæsthesia would be a questionable boon; as the work of the surgeon would be interrupted and often marred by involuntary struggles on the part of the patient. But very soon the spinal cord also is subdued, and the reflex functions of the cerebro-spinal axis are abolished so far as concerns the voluntary muscles, which consequently lie perfectly relaxed and passive, better suited for operative purposes than the most resolute will could render them. To this, however, there is one remarkable exception, viz., that the parts concerned in the respiratory movements remain active; and the same is the case with the sympathetic ganglia of the heart. In other words, when the administration of chloroform is carried to a certain point, the nervous system is deprived of such powers as would cause pain to the patient or inconvenience to the surgeon, but retains intact the faculties essential to life.

There are, however, yet other advantages derived from the inactivity of the cerebro-spinal centre. It seems now clearly established that the cessation of the contractions of the heart in the shock of injury depends upon an action of the brain and cord upon the cardiac ganglia through the medium of the vagus and sympathetic nerves; and chloroform, rendering this action impossible, protects the heart from the indirect effect of external violence. In this way it has greatly diminished the risk of death upon the operating table, and also has overthrown the old rule of deferring amputation in cases of injury till the patient has recovered from the state of collapse; thus shortening the period of mischief to the system from the presence of the mangled limb, and in extreme cases sometimes saving life where it would be hopeless to wait for returning consciousness. Indeed, an amputation performed under chloroform has often the effect of improving instead of lowering the pulse.

The most striking instance of this that has fallen under my notice, occurred in a laborer, whose right arm and thigh had been destroyed by a railway accident, just enough sound tissue being left to admit of amputation through the hip and shoulder joints, which was accordingly performed as a forlorn hope by the surgeon in charge of the case. The vital powers being in a state of extreme depression, it is probable that without chloroform this severe measure would have killed him outright, but by help of the anæsthetic it was followed by marked improvement of the pulse, which continued for some hours, so as to lead us to entertain hopes of his recovery.

Faintness during the operation, a species of shock, is also got rid of by chloroform; and this, besides its obvious convenience, has the advantage of lessening the chance of secondary hemorrhage; for the vessels which require ligature declare themselves as such by bleeding, instead of deceptively eluding observation in consequence of the feebleness of the heart and the general arterial contraction which coexist in the state of syncope.

The welfare of the patient is besides greatly promoted by the mental tranquillity arising from the prospect of immunity from suffering, which also induces persons to submit much more readily to the necessary operations, and often to undergo without hesitation treatment which was formerly impracticable because intolerable.

Such being the great benefits conferred by this agent, it is melancholy to reflect that in many parts of Europe, and even of the United Kingdom, it is either withheld altogether or given so scantily as to be nearly useless. This arises from fear, inspired by several fatal cases that have occurred. But when I state that Mr. Syme has given chloroform about five thousand times without ever meeting with a death, and that Sir J. Y. Simpson's experience, also very extensive, has, so far as I am aware, been equally satisfactory, it is clear that it may be used so as to be practically free from any risk whatever.

How then are the fatal cases to be accounted for? Heart-disease has been supposed to be a common cause of them; and it is a prevalent opinion that it is highly dangerous to administer chloroform to persons affected with cardiac disorder.

It happens that the only death I ever witnessed under chloroform occurred in a person whose heart proved, on examination, to be extensively affected with fatty degeneration, such as would be regarded as sufficient explanation of sudden death under any circumstances. The particulars of this case, however, presented peculiar features, which lead me to take a different view of the part played by the chloroform from what might at first be assumed. The patient was a man above the middle period of life, affected with cancer of the penis, for which amputation of the organ was to be performed. The gentleman in charge of the chloroform, considering the momentary nature of the operation, purposely abstained from giving it as fully as usual, and had removed the cloth containing it from the face before the operation was commenced. The surgeon now placed his finger on the patient's wrist, and having ascertained that the pulse was good, at once effected the amputation almost instantaneously. I observed that the passage of the knife through the member was accompanied by a start of the patient's body; the bandage used to control the bleeding was then removed, but no blood flowed from the arteries; he was found to have no pulse at the wrist; in short, he was dead. From these facts we can hardly doubt that death was a consequence of the shock of the operation acting on a diseased heart; and the only question is whether the circumstance that he had taken chloroform promoted that result. From the foregoing considerations, such a thing seems altogether improbable, as we have seen that chloroform protects the heart from the effect of shock. The fact that the patient started proved that reflex action was not abolished in the voluntary muscles, and confirmed the statement of the administrator that the chloroform was imperfectly given. My own impression is, that if it had been pushed to the usual degree, the fatal occurrence would have been averted.

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[1] For operations performed by artificial light, chloroform has another advantage over ether, in the fact that its vapor is not inflammable.

I have given this case in detail because I believe it may be regarded as typical of a considerable class in which death has taken place suddenly at the commencement of an operation with imperfect administration of chloroform, which stands to the fatal event in the relation of an accidental concomitant, or rather a preventive insufficiently used.[1]

A death essentially similar, though more obviously unconnected with chloroform, took place on the occasion when it was intended to administer it for the first time in the Edinburgh Infirmary; but Dr. Simpson being prevented from attending, the operation was commenced without the anæsthetic, and the patient died suddenly immediately after the first incision. It has been often remarked, that if the original intention had been carried out, chloroform would never have been heard of again in Edinburgh; but it is very likely that the man might then have lived to testify to its benefits.

There is another class of fatal cases in which the use of chloroform seems to have been simply a coincidence, the real cause of death being mental emotion, acting usually upon a disordered heart.

Dr. Snow mentions a distinct example of this, where a mere profession of administering chloroform was made, and the patient died of fright;[1] and I am able to give, from Edinburgh experience, an instance in which chloroform was still more remotely concerned. The late Dr. Richard Mackenzie being called to see a gentleman who had fractured his radius, had some thought of employing chloroform in examining the arm, but changing his mind, made the necessary manipulations without it. He then proceeded to leave the house; but had not got down the steps leading from the door when he was called back with the announcement that his patient had suddenly expired.

Had chloroform been held near the face a few seconds before this occurrence, it would certainly have been blamed, though with manifest unfairness; and a similar injustice seems to have been committed with regard to several cases in which fatal syncope has taken place early in the administration of the anæsthetic, when the brief period of inhalation concurred with the symptoms in showing that the patient was little, if at all, under its influence. A fear of the chloroform itself seems to have been the exciting cause in some of these cases; and one reason why no such instance has occurred in the Edinburgh Infirmary is probably the unlimited confidence reposed in this agent by the inmates of that institution.

It might, perhaps, have been expected *à priori* that chloroform, in the early or exciting stage of its operation, would act upon a diseased heart like mental emotion, and cause irregularity or cessation of its contractions. This, however, does not seem to be the case; and judging from my own experience, I should say that it tends rather to remove intermission or irregularity of the pulse. On the whole I believe that chloroform, by preventing shock and mental effort during the operation as well as anxiety before it, is in reality a great source of safety in heart-disease; and that if a person with known cardiac affection decides to place himself in the hands of the surgeon, so far from being unsuited for the anæsthetic, he is before all others the man who stands most in need of its protecting influence.

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[1] An observation made several years ago by Mr. Bickersteth, of Liverpool, has an interesting bearing upon this class of cases. He noticed on three occasions in amputation of the thigh that the pulse stopped suddenly at the moment the knife entered the limb, but recovered itself in a few seconds. The patients were under the influence of chloroform; but as Mr. Bickersteth never observed the same thing again, though he watched the pulse carefully at the same period in a great number of capital operations under chloroform, it seems probable that the anæsthetic was not administered to its full degree in those instances. (See Monthly Journal of Medical Science, September, 1853.)

[1] Snow on Anæsthetics, p. 201.

Nevertheless, even when the heart is perfectly healthy, it is quite possible to administer chloroform so as to produce a directly sedative and deadly influence upon the cardiac ganglia. This truth was deeply impressed upon me eight years ago by the following occurrence:—

> An eminent London physician, desirous of making some experiments upon the heart, selected a young donkey for the purpose, and requested me to maintain artificial respiration, which was done by means of a large pair of bellows connected with a tube tied into the trachea, the animal having been previously put under the influence of chloroform. The chest having been opened, the investigation was continued for a while, when the creature began to exhibit signs of returning consciousness. To avert this I removed the bellows, and poured into them a considerable quantity of chloroform, and resumed the artificial respiration with energy for a short time, the natural respiratory movements meanwhile continuing; when suddenly the heart, which lay exposed before us, ceased to beat, and refused to contract again, even when its muscular substance was pinched, which showed that its nervous apparatus was paralyzed.

This was no doubt caused by the air becoming highly charged with chloroform in passing over the extensive evaporating surface presented by the interior of the bellows. For it had been before shown by Dr. Snow, from experiments upon the lower animals, that an atmosphere containing more than a certain percentage of the narcotic vapor stops the heart before breathing ceases; whereas the reverse occurs when the chloroform is more diluted with air.[1] Hence, with the view of preventing fatal syncope, Dr. Snow contrived an inhaler for regulating the amount of chloroform vapor in the inspired air; and used it in upwards of four thousand cases, of which only one was fatal, and even that seemed to be so independently of the chloroform. Finding his ingenious efforts crowned with such success, and charitably supposing that all were as careful as himself, he concluded that fatal cases in the hands of others could result only from a faulty method of administration; and assuming that when chloroform is given from a folded cloth it is apt to be in too concentrated a form, he attributed most of the deaths that have occurred to paralysis of the heart from this cause.

But the cloth being the means which has been used from the first in Edinburgh, with success even superior to Dr. Snow's, I have been long satisfied that his argument was fallacious; yet as his special devotion to the subject, and the valuable facts which he has communicated regarding it, render his opinion influential, I have thought it worth while to subject a matter of such great practical importance to experimental inquiry; and, about the usual quantity of the liquid being employed, I find that, so far from the amount of chloroform given off from the cloth being in dangerous proportion to the air inhaled, the whole quantity which evaporates from the under surface even when the rate is most rapid, viz., just after the liquid has been poured upon it, is below Dr. Snow's limit of perfect security against primary failure of the heart.[1]

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[1] I have noticed, however, that different animals differ in their susceptibility to chloroform. Thus, frogs or mice may be kept for any length of time under its influence: but bats are very apt to die when treated in exactly the same way.

[1] The experiments were performed in the following manner: A cloth, similar in all respects to what would be used in practice, was supported upon a light wire frame-work, and suspended at a little distance from the floor by a thread, connected with one end of the beam of a balance, projecting over the edge of the table on which it stood. The weight of the cloth having been ascertained, a weighed quantity of chloroform, corresponding to fl℥iss., which is about the amount commonly used, was poured upon the middle of the lower surface of the cloth, which was then allowed to hang close above my face, so that I might breathe fully upon it, while inspiration was performed through a long India-rubber tube to avoid inhaling the chloroform vapor. The amount lost by the cloth was indicated by the weights in the scale at the other end of the beam. At the commencement of an experiment the weight was made a few grains less than the sum of the weights of the cloth and chloroform together, and an assistant noted the second when the scale with the weights in it came to preponderate; then removed ten grains so as to allow the scale to rise, and again watched the time of its descent; and repeated this process several times, thus obtaining a very accurate record of the rate of alteration in the weight. The lower surface of the cloth, which was made slightly concave, was circumstanced just as in the early period of the administration of chloroform, except that the inspired air was drawn from a distance. Inspiration does not, however, materially affect the rate of evaporation, as was found by experimenting with a cloth arranged above the mouth of a tube into which air was drawn by an appropriate apparatus. Allowance being made for the slight gain in weight that the

But, considering the great diffusibility of the vapor, and the large amount blown away in expiration, it is evident that only a small proportion of that which comes from the lower surface of the cloth really enters the lungs. Were it otherwise, it would be extremely dangerous to give chloroform with the cloth to infants; for as they inhale but a small amount of air, they would then breathe the vapor in a very concentrated state; yet all are agreed that infants are peculiarly favorable subjects for chloroform. In truth, the quantity dissipated into the surrounding air when the cloth is used involves considerable wastefulness in this means of administration, which is its only advantage as compared with an inhaler; but this is abundantly compensated by its greater simplicity, and consequent greater safety. For any apparatus which has the effect of preventing the free access of the atmosphere must be liable to operate in the same deadly manner as the bellows in the case above related; and even when constructed upon the best principles, it will require most careful management, as is admitted by Dr. Snow with regard to his own inhaler.[1] On the other hand, there can be no mistake about the manner of using the cloth, which is also always at hand under all circumstances.

The theory of syncope from too great strength of the anæsthetic vapor when the cloth is employed being erroneous, the greater number of the deaths still remain unaccounted for; and, if we except a very few instances for which we seem to have nothing to fall back upon but an idiosyncrasy so rare that it may practically be left out of consideration altogether, their explanation will, I believe, be found in an overdose of this potent narcotic from too long-continued administration.

This is what might be expected from a general view of the statistics. Were we to ask ourselves in what sort of operations we should have anticipated most frequent deaths during the employment of chloroform, we should say in those which are likely to inspire great dread on account of their magnitude and severity, and to cause great shock and great hemorrhage. More especially should these preponderate among fatal cases in general hospitals, where serious operations constitute the majority of those performed. The reverse of this, however, is what we actually find. Of the whole number of cases recorded by Dr. Snow, in 1858, as due to the use of chloroform throughout the world during ten years, nine only occurred in any considerable surgical procedure at a general hospital; remarkably few, considering the enormous number of important operations that must have been performed during so long a period, and the variety in the qualifications of those who administered the chloroform. On the other hand, fourteen took place at similar institutions in connection with the most trivial matters, such as the removal of a toe-nail, the amputation of a finger, the passing of a catheter, or the cauterizing of a wart. The only rational explanation of this seems to be, that when some great operation is to be performed, like the amputation of a thigh or the removal of a stone from the bladder, plenty of well-qualified assistants are present, and each of them, including the giver of the chloroform, is duly impressed with the importance of his office, and bestows the requisite pains upon it. But when some trifle is to be done, the whole affair is apt to be regarded too lightly, and the administration of the anæsthetic is perhaps confided to some unsuitable person, who also allows his attention to be distracted by other matters. This conclusion is entirely in accordance with my own experience, which, while it has convinced me more and more of the safety of chloroform if properly given, has impressed me deeply with the necessity for more vigi-

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cloth would obtain from absorbing moisture from the breath, the amount of chloroform lost from both surfaces together was thus easily determined. In order to ascertain how much escaped from the upper surface, experiments were made with the same cloth, having first the upper and then the under side securely covered with oil-silk, the arrangements being as above described, except that my face was not below the cloth. The quantity given off from the upper surface in a normal atmosphere was thus determined: and this being subtracted from the whole loss from both surfaces under the circumstances of inhalation, gave the amount that evaporated from the lower surface only. At the temperature of 70° F., this proved to be, from the average of several experiments, about at the rate of 24 grains per minute during the first half-minute; and allowing, with Dr. Snow, that 20 grains of chloroform correspond to 15.3 cubic inches of the vapor, and that 400 cubic inches of air are inhaled in a minute, we get 4.5 per cent. as the proportion of the chloroform to the inspired air, on the hypothesis that all that evaporates from the lower surface enters the lungs; 5 per cent. being what Dr. Snow was led by his experiments to regard as the proportion at which the respiration was quite sure to fail before the circulation, and that at which he aimed with his inhaler (op. cit., p. 84). On the other hand, Dr. Snow assumed that, when the cloth is used at a temperature of 70° F., 9.5 per cent. of chloroform is really inhaled (op. cit., p. 34); whereas, in truth, of the 4.5 per cent. a large amount is dissipated into the surrounding air.

[1] Op. cit. pp. 181, 188.

lant care in its employment than is sometimes apt to be bestowed.

But an overdose of chloroform may be caused by attention misapplied, as well as by want of attention. The requisites for safety in using it will be best introduced by a short account of what ordinarily occurs in the mode of administration with which I am most familiar. A common towel being arranged so as to form a square cloth of six folds, enough chloroform is poured upon it to moisten a surface in the middle about as large as the palm of the hand, the precise quantity used being a matter of no consequence whatever. The patient having been directed to loosen any tight band round the neck, and to shut his eyes to protect them from the irritating vapor, the cloth is held as near the face as can be comfortably borne, more chloroform being added occasionally as may be necessary. After a time, varying considerably in different individuals, but generally longest in adults who have been accustomed to the free use of narcotics, and shortest in young children,[1] signs of excitement begin to manifest themselves in various ejaculations and muscular efforts, which soon give place to a state of complete repose. The struggles of the patient are sometimes so violent as to require considerable force to restrain them; and, for this reason, at least one efficient assistant should always be in attendance. On the other hand, I have seen chloroform induce nothing but a tranquil slumber; and it is important to bear in mind that the stage of excitement cannot be reckoned on as invariably declaring itself at all.

The most convenient test of the patient being prepared for undergoing the operation is presented by the eye; not in the size of the pupil, which is inconstant in its indications, but in what is commonly spoken of as insensibility of the conjunctiva; though in truth it has no relation to sensation, which is abolished considerably earlier; but when unconscious winking no longer occurs on the eyeball being touched with the tip of the finger, we have a good criterion of the suspension of reflex action in the body generally. At this period the pulse is in about a normal condition, and the respiration is usually either natural or very slightly stertorous, though persons with a strong tendency to snore may do so almost from the commencement of inhalation. But if the administration of the chloroform be further persisted in, strongly stertorous breathing will soon be induced, and will become aggravated till it passes into complete obstruction to the entrance of air into the chest, though the respiratory movements of the thoracic walls still continue. Occasionally, however, the premonitory stertor is deficient, and the breathing becomes more or less suddenly obstructed. This is a point of great importance; for without close attention it may escape notice, when the patient will be placed in imminent peril. For though the respiration may be resumed spontaneously, this cannot be relied on, and it would seem that when chloroform is given in an overdose, the cardiac ganglia are apt to become enfeebled; and on this account asphyxia produces more rapidly fatal effects under its influence than in ordinary circumstances. But if the obstructed state of the breathing is noticed as soon as it occurs, and the cloth is immediately removed from the face, and the tip of the tongue seized with a pair of artery forceps[1] and drawn firmly forwards, the respiration at once proceeds with perfect freedom, the incipient lividity of the face is dispelled, and all is well.

I am anxious to direct particular attention to the drawing out of the tongue, because I am satisfied that several lives have been sacrificed for want of it. In order that it may be effectual, firm traction is essential. I have, more than once, seen a person holding the end of the organ considerably beyond the lips without any good effect, and, placing my hand on his, have given an additional pull, that has re-established the respiration.

A simple experiment, which any one may perform upon himself, is illustrative of this point. Stertorous breathing, such as occurs under chloroform, may be produced at will, and may be carried on even while the tongue is protruded to the extreme degree. But if the tongue is laid hold of with a handkerchief and pulled so as to cause decided uneasiness, stertorous breathing of any kind becomes impossible.

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[1] I once met with an instance in which chloroform seemed incapable of affecting a patient. It occurred in the private practice of Mr. Syme, who was about to perform an operation, for which we proceeded to administer the anæsthetic; but after we had used the cloth till we were tired without any apparent effect, Mr. Syme went on with the operation while the patient was conscious. Such a case is, no doubt, excessively rare; but it is interesting as giving some color to the hypothesis, that idiosyncrasy in the opposite direction has existed in some very few fatal cases, which seem to admit of no other explanation, as alluded to in the text.

[1] The artery-forceps are the most convenient means of drawing the tongue forwards. The puncture which they inflict is of no consequence; the patient, if he notices it at all, supposes that he has bitten his tongue when under the chloroform.

That further traction, when extension already exists to the utmost, should produce such an effect is an apparent anomaly, which it seemed important to explain. On investigating the subject, I noticed in the first place that stertorous breathing is of two essentially different kinds; of which one, that may be called *palatine*, consists in vibrations of the velum, and has either a buccal or nasal character, according as the air passes through the mouth or the nose; while the other, which is the profound stertor essentially concerned with chloroform, depends on a cause seated further down the throat, and, for reasons to be given immediately, may be termed *laryngeal*. By digital examination of my own throat, I found that the latter variety, and the complete obstruction into which it passes, could still be produced when the tongue was separated by a considerable interval from the back of the pharynx, while a free passage for the air existed onwards to the lips; which showed that the general belief, that the obstruction depends on a "falling back of the tongue," is erroneous. Also the epiglottis, instead of being folded back during the obstruction, as some have supposed, had its anterior edge directed forwards, and though it was thrown into vibrations when the stertor was strongest, it was evident that the cause of the sound was more deeply placed. I also found that, although firm traction upon the tongue abolished the obstruction and the stertor, it did not appear to produce the slightest change in the position of the base of the tongue; nor did it move the os hyoides upon the thyroid cartilage, as examined from without. Hence I was led to conclude that the beneficial effect of this procedure could not be explained mechanically, but must be developed in a reflex manner through the medium of the nervous system. The fact that, when sensation is perfect, some degree of pain is caused in the process, implying an irritation of the nerves, was in favor of this view; while the general abolition of reflex action by chloroform did not seem strongly opposed to it, considering that the reflex respiratory movements, including those of the glottis, go on in a person under the influence of chloroform.

For further elucidation of the matter, I had recourse to the laryngoscope; and, after a little patience, found no difficulty in inspecting my own vocal apparatus without employing any depressor of the tongue; using simply the small oblique long-handled speculum and a common mirror in bright sunlight. I then ascertained that the true laryngeal stertor results from the vibration of the portions of mucous membrane surmounting the apices of the arytenoid cartilages, *i. e.*, the posterior parts of the aryteno-epiglottidean folds (thick and pulpy in the dead body, but much more so when their vessels are full of blood), which are carried forwards to touch the base of the epiglottis during the stertorous breathing, and are placed in still closer apposition with it when the obstruction becomes complete. Having one hand at liberty, I was able to observe the effect of drawing forward the tongue under these circumstances, and I saw that firm traction induced the obstructing portions of mucous membrane in contact with the epiglottis to retire from it for about an eighth of an inch, so as to allow free passage for the air, while the epiglottis itself was not moved forwards in the slightest degree.[1]

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[1] While the true laryngeal stertor was thus produced and thus removed, a sort of spurious snoring might be made by approximation of the vocal cords; but this spurious stertor was, like the voice, quite unaffected by drawing out the tongue. These observations were made on September 21st of the present year (1861). I find that there are four ways in which the passage through the larynx may be closed. First, the folding back of the epiglottis over the opening into the pharynx, as is generally believed to take place in swallowing, and may be demonstrated by arresting an act of deglutition in its progress, and insinuating the finger between the tongue and the roof of the mouth to the epiglottis, which is then felt to be turned backwards, and to return to its usual position as the act of deglutition is finished. Secondly, an approximation of the sides of the superior orifice of the larynx, in which the epiglottis is directed forwards, but folded longitudinally, so that its edges are in contact with one another while the aryteno-epiglottidean folds are also in lateral apposition. This occurs in retching, and doubtless also in vomiting, when a folding back of the epiglottis, instead of protecting the larynx, would tend to direct into it the material passing from below upwards. Thirdly, an antero-posterior coaptation of the structures of the laryngeal aperture at a somewhat deeper level, without any change in the position or form of the epiglottis, towards which the folds of mucous membrane above the apices of the arytenoid cartilages are carried forwards, till they are in contact with its base. This is seen in coughing, and also in laryngeal stertor; and it is probable that during sleep, when the respiration is so apt to become stertorous, there is but a very narrow chink between the epiglottis and these folds of mucous membrane, which would thus serve to protect the deeper parts of the air passages from the introduction of foreign matters in the state of unconsciousness. Fourthly, the closure of the rima glottidis in the production of voice. The white chordæ vocales form a beautiful contrast with the highly vascular structures in their vicinity.

Whether pulling the tongue operates by inducing or relaxing muscular contraction in the larynx, may be matter for discussion; but the main conclusion, that it does not act merely mechanically, but through the nervous system, appears satisfactorily established. I have not hesitated to give the evidence on which it rests in full, as it appears to me to be of the highest practical moment. For it shows at once how grievous a mistake is committed by those who content themselves with gently drawing the apex of the tongue a little beyond the teeth, or pushing forward its base with the finger, or perhaps ascertaining that the epiglottis is not folded back. Such proceedings are instances of attention misapplied, and waste the golden opportunity for rescuing the patient from death. The proper treatment, like many other good things in medical practice, owes its origin to a false theory; but though the erroneous notion of obstruction by the tongue did good service in the first instance by suggesting the original method, it now tends to encourage supposed improvements upon it, which rob it entirely of its efficacy.

If the above description is correct; if it is true that when the administration of chloroform with the cloth is carried too far, the first serious symptom is an obstructed state of the respiration, which without watchful care may occur unnoticed, and, if allowed to continue, will endanger the life of the patient, but, if promptly treated, will harmlessly disappear,—it follows that the attention of the administrator ought to be concentrated on the breathing, instead of being, as it too often is, diverted by the pulse, the pupil, or other matters still less relevant.

As an example of the risk that is run by want of close attention to the respiration, I may mention the following case. A surgeon of considerable experience was giving chloroform to a patient on whom an operation was being performed, of which I was a mere spectator; but I noticed that stertorous breathing came on, and gradually passed into complete obstruction, at a time when the administrator was gazing with interest upon the proceedings of the operator. Seeing that the patient was in danger, I suggested to the giver of the chloroform the propriety of pulling forward the tongue. He replied that this was uncalled for, and pointed to the heavings of the chest as evidence that breathing was proceeding freely. Knowing from what had gone before that those efforts were doing nothing for the respiratory function, and feeling that there was no time for discussion, I stepped out of my province so far as to seize the tongue myself and draw it forward, when a long and loudly stertorous inspiration demonstrated the necessity for the interference. Had the delusive movements of the chest been trusted, it is probable that they might have continued till the heart had become so enfeebled by the asphyxial state as to cause no perceptible pulse at the wrist; and had death occurred under these circumstances, the case would have been set down as one in which the circulation failed before the respiration. The administrator would thus have been absolved from all blame; and the fatal event would have been attributed to idiosyncrasy, or to any heart-disease which might have been discovered on *post-mortem* inspection.

The very prevalent opinion that the pulse is the most important symptom in the administration of chloroform is certainly a most serious mistake. As a general rule, the safety of the patient will be most promoted by disregarding it altogether, so that the attention may be devoted exclusively to the breathing. The chance of the existence of heart-disease may seem to make this practice dangerous; but having followed it myself with increasing confidence for the last eight years, and knowing that it has been pursued all along by Mr. Syme, who has also acted on the maxim that every case for operation is a case for chloroform, and must, therefore, have given it to very many patients in whom cardiac disorder existed unknown to him, besides some in whom its presence had been ascertained, I feel no hesitation in recommending it. Even when serious disease of the heart is known to exist, it must be remembered that there is much less risk of syncope than of obstruction to the respiration; and while the latter will demand and repay immediate attention, the former, should it by any chance occur, being in all probability independent of any excess of chloroform, would not imperatively demand its continuance; nor would it be much influenced by treatment, supposing the patient to be already in the horizontal posture, which is generally considered safest in all cases when chloroform is given.[1]

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[1] From the views expressed in the text regarding the relation of syncope to the administration of chloroform, it might be inferred that no great danger would be incurred by giving it in the sitting posture when circumstances particularly require it; and accordingly Dr. Snow informs us that he has done this on several occasions without any bad result. But considering the possibility of an overdose, and the feebleness of the heart which it seems to entail, it is, no doubt, wisest, as a general rule, to have the patient reclining. Dentists, it is true, give chloroform in the sitting posture; but so far as I have seen, they do not carry the administration beyond a slight degree, sufficient to dead-

From these considerations it appears that preliminary examination of the chest, often considered indispensable, is quite unnecessary, and more likely to induce the dreaded syncope, by alarming the patient, than to avert it.

The obstructed state of the breathing, if allowed to continue long, would lead to a far more serious affection,—paralysis of the nervous centre concerned in the respiratory movements. Pulling out the tongue would then of course have no good effect of itself, but it should be done to clear the way for artificial respiration, which is the means to be essentially trusted to under such circumstances; and if the air still fail to enter freely into the chest, an opening ought to be made without delay through the crico-thyroid membrane. Cold water should also be occasionally dashed upon the face and chest; and if a galvanic battery happen to be in readiness, one of its poles may be applied over the spinous processes of the upper cervical vertebræ, and the other to the præcordial region, with the object of rousing the respiratory and cardiac ganglia. This, however, is a means not very likely to prove beneficial, and, if used in too intense a form, it may do harm instead of good. [I have seen life saved by it.—P.]

Preparatory to taking chloroform the patient should be directed to omit the last meal which would naturally precede it, as any food in the stomach is almost sure to give rise to troublesome vomiting during the inhalation. The only after-treatment necessary is to allow the effects of the chloroform to pass off in a quiet sleep; and the only bad consequence likely to arise is a tendency to sickness, which sometimes causes annoyance during the first twenty-four hours or so.[1]

Chloroform is universally applicable in the various departments of surgery, except in some few cases in which the assistance of the patient is required, and in operations involving copious hemorrhage into the mouth. Blood may trickle in small amount into the pharynx without risk of choking, deglutition being carried on unconsciously during anæsthesia; and even in some instances when the bleeding is more serious, as in removing portions of the jaws, pain may be avoided to a great extent by giving the chloroform during the more superficial parts of the operation, and allowing the patient to recover partially before undertaking its deeper stages.

The main conclusions arrived at in this article may be expressed in a few words. It appears that chloroform, though resembling many other valuable means of treatment, in being deadly when mismanaged, is free from danger if properly used; the following being the rules for its safe administration. A drachm or two of the liquid having been sprinkled upon the middle of a folded towel, hold it near the face, taking care that free space is afforded for the access of air beneath its edges, till the eyelids cease to move when the conjunctiva is touched with the finger. Meanwhile watch the breathing carefully; and if at any time it should become obstructed or strongly stertorous, suspend the administration and draw the tip of the tongue firmly forwards till the tendency to obstruction has disappeared.

These simple instructions may be acted on without difficulty by any intelligent medical man. The notion that extensive experience is required for the administration of chloroform is quite erroneous, and does great harm by weakening the confidence of the profession in this invaluable agent, and limiting the diffusion of its benefits.

[One danger should not be overlooked in the administration of any anæsthetic, viz., the plugging of the larynx by matters vomited or drawn backward from the mouth. Cases are upon record of death thus produced by artificial teeth (see p. 543), by the cork used to keep the jaws apart in giving nitrous oxide, and by other foreign matters. Fischer, of Hannover, reports a case in which a patient died while taking chloroform for an amputation, the symptoms being those of suffocation. At the autopsy a piece of chewing-tobacco was found obstructing the rima glottidis.—P.[1]]

The nine years which have passed since the above article was written have tended to confirm its main doctrines.

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en sensation without affecting reflex action, dexterously managing to open the mouth and operate upon it while the muscles of the jaws are rigid.

[1] It has been supposed by some that the use of chloroform increases the risk of pyæmia after capital operations; but experience has now abundantly proved the groundlessness of this apprehension. To take a single instance, the veins of the pelvic viscera being perhaps more liable than any others to originate phlebitis after surgical interference, lithotomy would be much more fatal now than formerly, were there any foundation in fact for the notion. The reverse, however, appears to be really the case. Thus, Mr. Cadge, one of the surgeons of the Norfolk and Norwich Hospital, an institution long celebrated for the successful treatment of stone, in a district abounding in calculous disease, informs me that the mortality after lithotomy has been still further reduced there since the introduction of chloroform. (Recent statistics of lithotomy at the Norfolk and Norwich Hospital will be found in the essay on LITHOTOMY in Vol. II.)

[1] [Schmidt's Jahrb., 1881, No. 6, from Deutsche Zeitschr. f. Chir., 1881.]

The safety of chloroform when administered according to the rules laid down in the preceding pages, has hitherto been verified without exception in my own personal experience; and I may add that Mr. Syme, though he continued to within the last two years in the full activity of his career as an operator, never lost a patient through its use, either in public or private practice. Further, I believe I am correct in stating that no case of death from chloroform has occurred during these nine years, in the operating theatre of either the Edinburgh or the Glasgow Infirmary, two of the largest surgical hospitals in Great Britain. Yet in both these institutions a folded towel, on which the anæsthetic liquid is poured, unmeasured and unstinted, is still the only apparatus employed in the administration: preliminary examination of the heart is never thought of, and during the inhalation the pulse is entirely disregarded; but vigilant attention is kept upon the respiration, and in case of its obstruction, firm traction upon the tongue is promptly resorted to. And it is worthy of special notice as showing that the success is due to soundness of the principles acted on, rather than to any particular skill, that the giving of the chloroform, instead of being restricted to a medical man appointed for the function, as is elsewhere often thought essential, is entrusted to the junior officers of the hospital. In Edinburgh, each of the five surgeons has two "clerks," intermediate in position between the house-surgeon and the dressers. They, besides other duties, take it in turn to administer the anæsthetic; and if I had to be placed under its influence, I would rather trust myself to one of these young gentlemen than to the great majority of "qualified practitioners."

The appointment of a special chloroform-giver to a hospital is not only entirely unnecessary, but has the great disadvantage of investing the administration of chloroform with an air of needless mystery, and withholding from the students the opportunity of being trained in an important duty, which any one of them may be at once called upon to discharge on commencing practice, and which, though certainly simple, is better performed after some practical initiation. I well remember the anxiety I felt on entering upon office as Mr. Syme's house surgeon, though I had before held a similar position in London, lest his first fatal case should occur in my hands; but this feeling soon gave place to perfect confidence, more especially after I had seen symptoms which would before have alarmed me, dispelled at once by traction on the tongue, which was then a novelty to me, and which is, I fear, even yet not duly appreciated by the profession generally.

> An incident which occurred during my Glasgow incumbency illustrates so strikingly both the value of drawing forward the tongue, and the relations of the circulation and the respiration to chloroform, that it seems right to place it on record. One of my colleagues in the Infirmary had been making an attempt to reduce a dislocation by means of the pulleys, chloroform having been given very fully by the house surgeon, who, at the close of the performance, removed the cloth from the patient's face, and proceeded to attend to other matters. Happening to be present, and observing that the respiration was deeply stertorous, I watched it carefully, and noticed that it passed almost immediately into the state of complete obstruction, though still accompanied by the movements of the thorax, the face meanwhile becoming markedly livid. Unwilling to interfere, and seeing the carotid pulsation conspicuous in the neck, I waited a while, hoping that the obstacle to the breathing would disappear spontaneously. But instead of this I soon saw to my horror the lividity give place to what I knew was physiologically identical with *post-mortem pallor*. I now rushed forward, and drew the tongue out firmly with the artery forceps; air at once passed into the chest, and the man was rescued.

This case seems to me fraught with the deepest instruction.

There can be no doubt that the patient was on the very verge of death; that if the laryngeal obstruction had lasted a very short time longer, the respiratory and cardiac ganglia would have failed in their functions. Supposing the administrator to have continued the chloroform with his attention devoted to the circulation, the first thing that would have alarmed him would have been the failure of the pulse at the wrist. On removing the cloth from the face, he would have seen the deadly pallor; and ignorant of the asphyxial lividity which had preceded, he would have taken it as positive evidence of primary failure of the heart; a verdict in which the whole profession would probably have supported him, whether valvular disease or fatty fibres could or could not be discovered on post-mortem inspection. The case, then, reads us another striking lesson on the paramount importance of taking the respiration as our guide, and shows how readily, if this be not done, a death due to the grossest mismanagement may be regarded as the inevitable result of constitutional peculiarity.

The case also shows the necessity of keeping watch for a while after the administration has been discontinued. The last portions of the vapor inhaled seem to take some seconds at least before they produce their full effects on the nervous centres; and the patient should not be left till he has been seen to breathe calmly and freely for some minutes after the cloth has been removed.

On one occasion only, so far as I remember, have I seen firm traction on the tongue fail to remove laryngeal obstruction. In that instance the chest continued to heave, but no air entered or escaped, although the tongue was well drawn out. Happily, however, the desired effect was instantly produced by slapping the face with a towel dipped in cold water, while the traction on the tongue was maintained. This fact is interesting, not only as a striking illustration of the value of the sudden application of cold under such circumstances, but also because it confirms the explanation before given of the *modus operandi* of traction on the tongue, viz., that it operates not mechanically, but through the nervous system. For here the barrier to the entrance of air into the chest remained in spite of the clearing away of any obstacle which the tongue might be supposed to present, but that barrier was at once removed by a means which could not act in any other way than through the nerves.

It is nevertheless true that the tongue does frequently fall back under chloroform, and so occasion a mechanical impediment to respiration. It recedes, no doubt, in consequence of relaxation of the lingual muscles; and accordingly thick or obstructed breathing depending on this cause may be very simply cleared by pulling the beard or a fold of skin below the chin so as to draw forward the lower jaw, and act on the tongue through the medium of the muscular fibres which pass back to it from the maxilla. Turning the patient's face well round to one side, so as to cause the weight of the relaxed organ to tell laterally rather than backward, is another way in which a needless puncture of the tongue may often be avoided. But it must always be borne in mind that neither of these means can be expected to succeed if the obstruction exists in the larynx, and if they do not answer their purpose, not a moment should be lost in applying the artery-forceps.

Whenever it is necessary to draw the tongue forward, it is of course equally needful to suspend the administration, by taking the cloth entirely away from the neighborhood of the face. To act otherwise would be to pour in a fatal dose after artificially removing the natural safeguard against its entrance. To give a caution against so obvious a breach of physiological principle may seem superfluous, but I know by experience that it is not uncalled for.

I have admitted in the foregoing article that idiosyncrasy may have been the cause of death in some anomalous cases which have been put on record. We certainly see strange varieties in the effects produced by chloroform both on the cerebral and the spinal centres. Some persons when inhaling it lie from first to last as in a tranquil slumber; some, before they succumb to its narcotic influence, struggle with great violence, without uttering a sound; others bawl lustily, while some sing sweetly, and others again are disposed to converse quietly though incoherently with those around them. There are also remarkable differences in the relation of sensation to consciousness under chloroform. As a general rule they are affected simultaneously, but we now and then see patients insensible to the pain of an operation, though perfectly conscious of all that is passing. Equally various are the effects upon the spinal functions. The absence of winking when the eyeball is touched with the finger, though a very good general guide to the abolition of reflex action in the body generally, is by no means an unvarying indication. In some persons that particular function is abolished earlier or later than usual. Relaxation of the sphincters of the bowel and bladder is a result of chloroform happily only occasionally met with, and various other instances of exceptional phenomena might be mentioned. Another example of peculiarity, more closely bearing upon the question of death from chloroform, has come under my observation in two instances during the last nine years, viz., cessation of the movements of the thorax, or in other words suspension of the function of the respiratory ganglia, without any preliminary laryngeal obstruction; although there was not, so far as I could judge, anything unusual in the mode of administration. In both cases natural breathing soon returned under artificial respiration maintained by intermitted pressure on the false ribs, while the tongue was drawn forward, accompanied by occasional slapping of the face and chest with a cold wet towel. But the condition was sufficiently alarming while it lasted. The patients were both elderly, feeble subjects: and I may remark that if I ever give chloroform with any degree of apprehension, it is to the aged and infirm.

Another closely allied instance of idiosyncrasy once presented itself in my practice. I had removed under chloroform a small epithelial cancer from the eyebrow of a feeble old woman, nothing unusual having occurred, when I noticed that the breathing assumed a peculiar sighing character, and the intervals between the sighs became greater and greater till I began to fear their entire cessation. However, normal respiration returned, and in the course of a few minutes she got up and sat in a chair beside the fire. But she had not been there long before the same strange slow breathing came on again, as if she would sigh her life away; and I believe that if I had not had her put back promptly to bed, she would actually have died. Here a feeble frame was further weakened by the potent narcotic, and it happened that the effect told especially upon the respiratory function, with the peculiarity that it was manifested not during the administration of the chloroform but subsequently.

With these examples before us of deviations from the usual order in which the various functions of the nervous system are effected by chloroform, no one can say it is impossible that here and there an individual may be found so constituted that, without any undue proportion of the narcotic vapor to the air inhaled, the cardiac ganglia may fail before the respiration is interfered with. But while freely admitting that such a thing is possible, I must repeat my firm conviction that this kind of idiosyncrasy is certainly "so rare that it may practically be left out of consideration altogether."

The danger of chloroform may be compared, not inaptly, to that of railway travelling. In both cases the risk incurred by any individual is so small that it does not enter seriously into our calculations. And just as railway accidents are generally occasioned by culpable mismanagement, so death from chloroform is *almost invariably* due to faulty administration.

[In certainty of effect, in celerity of action, in facility of administration and management, and in pleasantness to the patient, chloroform still remains the king of anæsthetics. Yet a very great change in its relative position to ether has taken place during the decade which has elapsed since the publication of the second edition of this work. The current of professional opinion has been setting strongly against chloroform and in favor of ether, despite the great practical disadvantages of the latter, such as unpleasantness to the patient, difficulty of administration, and the disturbed and unreliable character of its anæsthetic sleep. In many large public institutions and cities, and throughout large sections of this country, chloroform has been entirely abandoned, and ether substituted for it.

One influence, and one only, has produced this change: an increased conviction of the danger attending the use of chloroform. Deaths under its influence have multiplied until the profession has been forced to consider them; journals and men of high standing have repeatedly called attention to the frequency of their occurrence; finally, the text-books of materia medica have embodied in their teachings the general conviction of the profession that there is danger attending the use of chloroform which no foresight can discern, no precaution avoid, and no skill avert; nor do they hesitate to draw the legitimate inference that a resort to this agent, when a safer one is available, is therefore unjustifiable, if not criminal.[1]

It may seem to follow from these statements that there remains nothing further to do but to record sentence of banishment against chloroform, and to close the article. Chloroform, however, will still be used in surgery. The exigencies of military life will not allow its bulkier rival to displace it from army practice. The inflammability of the vapor of ether will not permit its use for operations by artificial light, and there are some surgical procedures in regard to which it still remains an open question whether the good of the patient is not best promoted by the use of the stronger agent, even with some additional risk. Moreover, chloroform still has friends, warm and enthusiastic friends; they are not mere theorists, but men of very large experience in actual practice, whose convictions, derived from actual observation, deserve consideration and command respect. They claim that a large percentage of the accidents from chloroform have been the result of improper or careless administration; that the actual risk of chloroform is so small that it is counterbalanced by its great practical advantages; that the relative danger from the two agents has never been determined; and that, since with the increased frequency of use of ether, deaths from its use are multiplying, it is by no means certain that the one agent is so very far safer than the other. That these men are as honest, as conscientious, and as fully impressed with the responsibility of their decision, as are the friends of ether, cannot be denied.

Many reasons exist, therefore, for devoting to chloroform careful study, and for presenting such advances of knowledge as may have been made during the past ten years. Especially should everything relating to death from this agent receive earnest consideration, because widely divergent views are held as to the mode in which it takes place, and because much yet remains uncertain and unknown in regard to it. Whatever conclusions may be reached from such a study, lessons of great practical value cannot but result.

No more statistics exist now than at the beginning of the decade, upon which to base a numerical statement of the actual amount of danger from the adminis-

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[[1] Materia Medica, by Roberts Bartholow, New York, 1878; Therapeutics, by H. C. Wood, Jr., Phila., 1874; National Dispensatory, Stillé and Maisch, Phila., 1879.]

tration of chloroform. While pages might be filled with general estimates, the only reliable figures are still those made up by B. W. Richardson from examination of English hospitals.[1] These are especially valuable because the administrations were to patients of both sexes, of all ages and conditions, and always made by qualified medical men, and because all doubtful cases were excluded. Moreover, both administration and death were subject of record. The books of sixteen hospitals, from 1848 to 1869, give 35,162 administrations, with eleven deaths; one in 3196. It may be supposed that the records of our late war would furnish accurate information, but, unfortunately, this is not the case. The statement of 80,000 administrations of chloroform, ether, and mixtures of the two, is but an estimate.[2] The deaths, however, are given as matter of record, and number seven, of which six were clearly and undisputably caused by chloroform. It could scarcely be expected that records of the Confederate armies exist. In their absence, the following, from a gentleman in high official position, cannot but prove of interest: "In the administration of chloroform, which was the only anæsthetic resorted to, by a general order from the Bureau, surgeons were directed to precede its use with stimulants; and, although it was the universal practice, both in the field and in the hospitals to employ this agent, I have not been able to find that a single case of death from its use was ever reported."[3]

The army records of foreign countries are not accessible, but it is stated that in the statistics published by the French Minister of War, no death from chloroform, the anæsthetic used in the army, is recorded from 1864 to 1875.[4]

The difficulties in the way of reaching correct conclusions as to chloroform deaths are neither few nor light. Of the 375 cases[5] many furnish no information. There must be eliminated, in justice, all those in which the agent was given by an unqualified person, all the cases of self-administration, and all those in which a severe surgical operation or considerable loss of blood might have powerfully aided in causing the fatal result. To no single individual surgeon have fatal cases enough occurred to permit a comparison, and whenever a death does occur the circumstances are in the highest degree unfavorable for close observation and clear record, so that the well-observed cases useful for study are but a small proportion of the whole number. There is, moreover, a logical difficulty prominent throughout anæsthetic literature. It is the constant and very natural tendency to decide all questions from personal experience. The amount of danger, the manner of death, modes of administration, measures of precaution and of resuscitation, in regard to both chloroform and ether, are decided over and over again from the experience of the individual, or from the records of a single institution. Yet upon no surgical subject is a collection and comparison of all the facts, and a survey of the whole field more necessary than here. He who bases a belief in the absolute safety of chloroform upon five or ten thousand administrations without accident, which he has witnessed, is not willing to receive one death in 525 administrations as the rate of its mortality. Yet this is the record of one hospital as given by Richardson, and if one experience will serve for a decision, so ought the other. But there are wider variations than this. Thus, in France, with 40,000,000 inhabitants, there were nineteen deaths in ten years, while in England, with 35,000,000 inhabitants, there were seventeen deaths in eighteen months.[1] With a full allowance for deaths not reported in the former country, the difference is still enormous. The experience of any single individual, or of any one institution, or even country, is not, therefore, sufficient as a basis of decision upon many questions in regard to anæsthetics.

A careful examination of those fatal cases which have been fully and accurately reported reveals several well-marked and distinct modes of death.

First, there is a death by obstructed respiration, as described in the text (p. 527). The chloroform being pushed, respiration becomes more and more deeply stertorous, and the well-known symptoms of asphyxia are shown in the countenance. Paralysis of the tongue is an accident which may suddenly occur under these circumstances; falling backwards it obstructs the entrance of air, and more or less produces or complicates this condition.

From great danger, thus induced, many patients have been rescued. That death has been many times caused in this way is very doubtful, at least in times more recent than the early days of anæs-

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[[1] Medical Times and Gaz., 1870.]

[[2] Circular No. 6, Surgeon-General's Office, 1865, p. 87. Direct information from the department is to the effect that up to this time no statistics have been compiled.]

[[3] From an address by H. Y. Garnett, M.D., of Washington, on the Medical Department of the Confederate Government, and some advances made by Confederate surgeons.]

[[4] M. Perrin, Congrès Medical International, Bruxelles, 1875.]

[[5] Anæsthetic Manual, by Dr. L. Turnbull, Phila., 1879.]

[[1] M. Perrin, Congrès Int., Bruxelles, 1875.]

thesia. The warning is distinct, the danger apparent, and a death in this way could only result from gross inattention or palpable maladministration.

Second, a death with like symptoms to the above, may occur before the patient is fully under the influence of the chloroform, and is therefore certainly not caused by an "overdose." The period of excitement which comes between total loss of consciousness and complete anæsthesia, is in some patients, especially muscular and robust subjects, most strongly marked, and causes extreme interference with the respiratory process. To the mental excitement, sometimes exhibited and manifested by loud exclamations, shouting or singing, are added irregular muscular contractions, struggling, efforts to get up, rigidity of extremities, or of the whole body; and there may be opisthotonos or even general convulsions. During this period the muscles of respiration are the subject of tetanic spasm, and breathing is sometimes suspended for a considerable period. During this period death has very frequently suddenly occurred. The circumstances are not favorable to a careful observation of the pulse; yet in many reports it is distinctly stated to have been felt beating after respiration had ceased, and these cases, as well as the class preceding, may be termed death by asphyxia, indicating that death commenced with the respiratory process. Whatever terms may be used, there is sufficient evidence of the great danger attending this particular period of the process of anæsthesia. Death occurred at this period and in the manner described, seven times in forty well-observed cases.[1] Convulsions indicate especial danger; in twenty-eight cases they immediately preceded death, being seventeen times spasmodic and eleven times tetanic in character.[2]

Third, death occurs through respiration, but in an entirely different manner. The nervous centre presiding over the function is now evidently affected. All at once the process becomes irregular and extremely feeble, or the paralysis is complete and the patient suddenly ceases to breathe, the heart continuing its action until death overtakes that organ also. In one case the cardiac sounds were heard for ten minutes after cessation of the respiration. This mode of death is recognized in the text as an exceptional peculiarity of the action of chloroform. In two cases there was observed "*suspension of the function of the respiratory ganglia*, without any preliminary laryngeal obstruction," and without "anything unusual in the mode of administration."

Of Kappeler's forty well-observed cases, death took place in this manner ten times, or in twenty-five per cent. These may be called deaths by *respiratory paralysis*.[1]

Fourth, sudden death under chloroform takes place also, and with somewhat greater proportionate frequency, through the organs of circulation. The pulse begins to fail, flutters and disappears, and the patient is all at once in a most precarious condition; or the heart suddenly stops beating, and he is dead. This may occur without the slightest warning. The surgeon's attention is attracted by the cessation of bleeding from the wound, he looks up and sees the patient's head drooped, his face fallen, the countenance pallid, the pupils dilated, and finds that death has taken place. Respiration has continued feebly in a few cases for a brief period, but it generally ceases simultaneously with the heart's action.

This form of death has been called sideration and syncope; it is death by *cardiac paralysis*, and the records contain an abundance of examples. Indeed, so frequently have the above symptoms been presented that this form of death has been taken as the type, and the respiratory form has been overshadowed and lost sight of.

Death by sudden cessation of cardiac action has been believed to result from a direct depressing influence of chloroform on the muscular structure of the heart. This view obtains some support from the effect of the vapor when blown on the exposed heart of an animal, but the extreme rapidity with which the fatal event takes place, and the general uselessness of all measures of resuscitation, point to the nervous system as the origin. This is the opinion of some of the best authorities. Koch holds the alleged action on the cardiac muscle as highly improbable, but says "it may justly be maintained that the chloroform, immediately after its reception into the circulating fluid, effects a paralysis of the musculo-motor cardiac ganglia."[2] Kappeler says that a direct action on the heart yet requires proof, while "a sooner or later appearing paralysis of the cardiac and respiratory motor centres in the medulla oblongata may be with certainty assumed."[3]

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[1] Kappeler, Well-marked cases, London Lancet, Jan. 17, May 16, 1874; Snow, Case 33, p. 170.]

[2] Lallemand and Perrin, Traité d'Anæsthésie Chirurgicale, Paris, 1863, p. 411.]

[1] Cases Nos. 36, 83, 86 of Kappeler's table; No. 34 of Snow's collection. In all it is distinctly stated that the heart was beating after respiration ceased.]

[2] Ueber das Chloroform, von Dr. Wilhelm Koch, Klinische Vorträge, No. 80; Chirurgie, No. 26.]

[3] Page 120.]

Richardson says: "Let us bear in our minds the truth that chloroform, when it kills, kills not necessarily by its action on the muscular structure of the heart, but by its influence on the nervous mechanism of the heart."[1] It is then by a sudden profound impression, the nature of which is not yet known, upon the cardiac and respiratory nervous centres, singly or together, that chloroform exerts its deadly influence.

The most important practical fact connected with this cardiac death is that it may be brought about by the interference of the surgeon or the action of the administrator. The former has been shown in clinical experience by the fatal event following instantly upon the first painful impression. The frequency with which this has occurred when the impression has been particularly sharp and sudden, as in tooth-drawing, has been matter of frequent comment. In these cases the heart is affected by reflex, not by direct, influence. Attention was first directed to a marked influence of the surgeon's knife on the pulse by Mr. Bickersteth. The subject was next taken up by Vigaroux and carried by him to extremes, as he maintained that such reflex actions might take place even in deep anæsthesia. Snow investigated the doctrine and rejected it, then Lallemand and Perrin made it the subject of special study, and satisfied themselves of its truth. They observed that painful impressions, even such as passing a suture needle in a state of partial anæsthesia, did produce a marked effect upon the pulse. Richardson's testimony is very strong and seems to sustain Vigaroux. Even in deep anæsthesia, during ovariotomy, he noticed that when the operator first puts his hand into the peritoneum, or when he uses the sponge to clear out the abdominal cavity, there is an alteration in the beat of the heart, a quickness of beat with feebleness, and even with intermittency." During forced bending of a knee-joint, "with each act of the operator the pulse stopped for the moment as if it had been mechanically arrested, and then after a pause recommenced its beat."[2] This was observed three times. No better example of death resulting in this manner can be found than that related in the text (p. 527), and no one who has examined the evidence can fail to agree with the opinion there expressed, that if the anæsthetic "had been pushed to the usual degree the fatal occurrence would have been averted."

Case.—Adult female; no organic disease; had taken ether for dental purposes before; position, recumbent before an open window. "She never lost consciousness, but would indicate by a wave of the hand that she was ready. This she did until the last of three fangs had been removed, when, quick as thought, a deathly pallor came over her countenance. She died without a struggle."[1]

It must be conceded that by this manner of death can best be explained that preponderance of fatal cases when chloroform is administered for minor operations, which is so marked a feature of the record, the proportion being as high as forty per cent.[2]

In the other mode of death by reflex action the administrator is the active agent, the impression being the sudden and powerful influence of concentrated chloroform vapor upon the nasal and upper air-passages, or upon the lungs, causing immediate cessation of the heart's action, or of the respiratory movements. Rutherford showed that not only chloroform, but any irritating vapor, as ammonia, brought suddenly to the nose of a rabbit, caused a "cessation of respiration often for thirty or forty seconds. Within three seconds after the cessation of respiration, the heart comes almost to a stand-still, and continues to beat very slowly until respiration is re-established."[3] The Chloroform Committee of the Royal Medico-Chirurgical Society called attention to the suddenness of death of animals at an early period of the administration, when the air was charged with a large percentage of vapor. Holmgren published his investigations in 1867, and they were verified by Koch, showing that the sudden inhalation of concentrated vapor caused a cessation of breathing for sixty seconds, with diminution of the heart's contractions, a condition from which the animals were rescued with difficulty. The same effect was shown by Holmgren to follow even when the animal breathed pure air through a canula introduced into the trachea, and Knoll, by introducing the vapor through a canula and leaving the upper air-passages unaffected, likewise caused sudden death.[4] The case of the donkey in the

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[[1] Med. Times and Gaz., July 23, 1870.]

[[2] Med. Times and Gaz., July 23, 1870.]

[[1] From a paper by W. W. Dawson, Cincinnati Lancet and Observer, Jan., 1871. Additional examples, Case 36, Snow's collection, Boston Med. and Surg. Journ., May 19, 1864; Edin. Med. Journ., Jan. 1866; British Med. Journ., vol. i., 1878. In the latter the patient died instantly upon division of a fistula in ano.]

[[2] Sansom on Chloroform, London, 1865, p. 69.]

[[3] Quoted by Richardson from Journ. of Anat. and Phys., May, 1869.]

[[4] Koch, Klinische Vorträge, p. 584. Kappeler.]

text (p. 528), seems an instance of this. In experiments, the results upon the heart and respiration failed to follow if the vagi had been previously divided. Finally, the testimony of the present Anæsthetic Committee of the British Medical Association[1] is to the same effect. "When the animal is not fully under chloroform, *any fresh administration* causes most remarkable variations in blood-pressure, with retardation of the heart's contractions. There is frequently a sudden dip in the pressure to the extent of forty millimetres out of a total of one hundred and ten. This occurrence followed so uniformly, in certain stages of chloroform narcosis, on every approximation of a sponge containing the agent, even for a few seconds, to the animal's muzzle, that it was regarded as probably reflex."

By this explanation of death some of the knottiest points connected with the subject are cleared up. It will explain, and no other theory will satisfactorily do so, why a patient may die under chloroform who has taken it safely many times before; how but a very small quantity may cause death, and how death may take place at a very early period of the administration, after, perhaps, but a few inspirations. Of Snow's fifty cases, nine died within a minute after commencing to inhale, and four of these within a few seconds. Kappeler recognizes these cases as brought about "by reflex action through the vagus and trifacial nerves, causing cessation of the respiratory and cardiac movements," and Richardson says that "these patients have died from the direct action of the vapor on the nervous periphery of the breathing surface."[2]

Abundant clinical experience exists to supplement theory and experiment on animals:—

Case.—Adult female; healthy. "Complete insensibility was not produced at the first trial; more chloroform was placed on the handkerchief, and she *drew a full inspiration.* Her countenance *immediately* became pallid, her features altered. She died as if struck by lightning.[1]

Of a collection of 133 fatal cases, sixteen appeared to die in this way; in eight of them death followed *immediately upon the addition of a fresh supply of chloroform* to the towel or other apparatus.[2]

A multitude of instances of narrow escape could be given, in which the dangerous symptoms were produced in this way. These may serve as examples:—

Case.—Female, 32 years old, healthy, vigorous, in the sitting position. *From the full and deep inspiration of three drops*, the patient dropped as suddenly as if smitten by lightning. Rescued by artificial respiration.

Case.—Female; proposed operation, removal of mammary gland. "She sank at the *first* inspiration and came very near losing her life. It was over four hours before I considered her free from danger. She had a series of depressions, one following the other, until she finally came around by the aid of brandy, ammonia, etc."[3]

If apology be necessary for the amount of attention devoted to these two classes of deaths, it may be found in the fact that recognition of them renders an avoidance of them possible. The valuable practical lessons are, that in a state of partial anæsthesia the patient is exposed to peculiar danger, and that dilute vapor is essential to safety, forced and rapid chloroformization being especially dangerous.[4]

[[1] Consisting of Joseph Coats, M.D., Pathologist, Glasgow, Wm. Ramsay, Ph.D., Prof. of Chemistry, and John G. McKendrick, Prof. of Physiology. Report in Brit. Med. Journal, 1879.]

[[2] Med. Times and Gaz., May 28, 1870. No recognition of this mode of death has been found abroad previous to this date. In this country it was first mentioned by Dr. Henry J. Bigelow, of Boston, as early as 1848, in a paper on "Anæsthetic Agents" in vol. i., of the Transactions of the American Medical Association, p. 213; and again by Brown-Séquard, in his "Lectures on the Pathology and Physiology of the Central Nervous System." The writer was convinced of the truth and importance of the doctrine from the overpowering effects of single inspirations sometimes experienced during self-administration, and he taught it in 1861, and urged it upon the attention of the profession in 1867, Am. Journ. Med. Sci., Jan. and Oct.]

[[1] Snow, Case 11, p. 142.]

[[2] Am. Journ. Med. Sci., Jan., 1867, p. 178; Oct., 1867, p. 329; or Lallemand and Perrin's list in Traité d'Anæs. Chir., cases 11, 12, 16, 18, 26, 35, 40, 47, 66.]

[[3] Communicated to the writer, the first by an eminent surgeon of Ohio, the second by one of Alabama.]

[[4] Confirmation of the views here presented in regard to death by reflex action is given in an article recently come to notice, read before the Academy of Science of Paris by M. Vulpian, "L'action qú' exercent les anesthésiques (ether sulfurique, chloroform, chloral hydrate) sur les centres respiratoires et sur les ganglions cardiaques," Comptes Rendus, Jan.-June, 1878, p. 1303. The article is too long to present in full, and only some points, too important to be omitted, are selected and italicized.

Beginning by stating that Weber has shown that after division of the pneumogas-

No consideration of the effect of chloroform in causing death can be complete without including those cases in which the danger is only manifested after the administration has ceased for a considerable period. Such cases there are, and thus far they defy all rational explanation. To impute them to a continued absorption of the vapor from the "residual" or "supplemental air" in the lungs, and thus to an "overdose," will not bear examination. The residual and supplemental air of respiration bears to the "tidal current" the proportion of 5 or 7 to 1; the aggregate of the former being from 150 to 200 cubic inches, the latter averaging about 30 inches.[1] Less than half a minute will suffice, therefore, to change all the air in the lungs, while the dangerous symptoms from chloroform have appeared a very much longer time than this after its administration had ceased. The Anæsthetic Committee reports that in two instances a sudden failure of the heart's action was observed "more than a minute after chloroform had ceased to be administered, and after recovery of the blood pressure."[1] Clinical evidence is abundant. There is the striking case on p. 535.

Possibly objections may be made to the well-marked case given by Snow[2] on account of the early date at which it occurred, and as not having been well observed, the surgeon having left the ward before the danger was perceived. But the occurrence of such cases does not depend upon one or two observations.

Case.—Boy, aged 8; operation to explore abscess of knee for a needle. Heart examined by two medical men. Operation finished, wound dressed, chloroform *had ceased to be administered for about five minutes* when lividity of countenance was noticed. Artificial respiration and galvanic battery used for nearly three quarters of an hour without avail. Post-mortem examination showed no heart disease.[3]

Case.—A young lady, in *perfect* health; administration for extraction of a tooth. A *full minute* after chloroform had been withdrawn, the breathing was tranquil, the pulse steady, the countenance natural. All at once respiration became feeble, the heart's action imperceptible, and the limbs flaccid. Three hours elapsed before she was in a satisfactory condition.[4]

Case.—Female, age 34; had taken chloroform six times for operation on lupus of face. At seventh operation pulse and respiration regular and good until it was completed. After completion, and *about two minutes* after removal of the chloroform, the patient suddenly became pale, pupils dilated, pulse and respiration failed, and in a few seconds ceased. All efforts at resuscitation failed. The post-mortem examination gave no explanation.[5]

Case.—Adult male of plethoric habit; operation, fistula in ano. Brought under the influence of chloroform with some difficulty; at least one minute before the completion of the operation the administration had been suspended. The patient *aroused sufficiently to answer one or two interrogatories*, and the order had been given to remove him from the amphitheatre, when he was seen to gasp, and

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tric nerves in the neck of animals, faradization of the peripheral or thoracic ends, even with a current of medium intensity, produces suspension of the movements of the heart, and that Traube's experiments showed that with a current of considerable intensity, irritation of the cephalic ends determines immediate arrest of the respiratory movements, he goes on to state the effects produced in animals under the influence of curare, chloral, and the anæsthetics. These agents modify, but do not change the general results obtained by these excitations. When sufficient chloral to produce profound sleep is injected into the veins of a dog, the cardiac and respiratory movements continue, but physiologists *not rarely* meet with cases, especially when the chloral *has been rapidly introduced*, in which the animal suddenly ceases to respire, a sort of *respiratory syncope* is produced, the heart usually beating a few minutes longer. Artificial respiration by faradization generally restores the animal. Again, another accident often occurs with animals thus treated, and is irremediable. The heart stops more or less suddenly while the injection is going on, *or when some experiment is made affecting sensitive nerves*. The heart's action ceases before respiration, and it is very rarely that faradization rescues the subject from this *cardiac syncope. The same occurrences take place in animals anæsthetized by ether, chloroform, or other analagous agents.*

It is shown, therefore, that in anæsthetized animals, and particularly in those under the influence of chloral, *the respiratory centre undergoes notable modifications*; it becomes paralyzed from the irritations produced during the vivisection. And again the *excito-motor ganglia of the heart are also paralyzed*, either by an excessive quantity of chloral administered, or by *reflex action from the traumatic irritations*. Often a faradization of the superior segment of the nerve for only a few seconds suffices to effect a cessation of respiration, which would be fatal, unless energetic measures of rescue are put in force, and if the inferior end is irritated, not only does the heart stop in diastole, but it stops definitely.]

[[1] Carpenter's Physiology, 8th ed., Phila., 1876, p. 386.]

[British Med. Jour., June 21, 1879, p. 923.]

[[2] Page 197.]

[[3] British Medical Journal, March 8, 1879.]

[[4] B. W. Richardson, Med. Times and Gaz., May 14, 1870.]

[[5] Kappeler, p. 65; the case occurred under his own observation.]

death followed in a few minutes, in spite of artificial respiration. At least *three minutes* elapsed from the time administration ceased until dangerous symptoms set in.[1]

A full survey of the whole field, a careful study of all the deaths, fail to detect a similarity upon any one point common to all, or to any considerable majority. Eliminating the cases in which the agent has been mal-administered or common-sense rules of safety have been violated, still death has not infrequently taken place under chloroform in the hands of the most careful and experienced administrators, in institutions where every minute precaution has been observed, when the most carefully determined amount of vapor had been inhaled. It has occurred to patients of all ages, to the most healthy, and for the most trivial operations. The danger has often appeared without the slightest warning, and sometimes after the administration had ceased. The conviction is forced that the danger cannot be foreseen and cannot be averted; in other words, that the remedy is uncertain and irregular in the manifestation of its effects. Experiments on animals most plainly show this: that "chloroform has sometimes *an unexpected and capricious effect on the action of the heart of animals, and that it shows a great variation of effect in the same animal at different times*" is stated in the report of the Anæsthetic Committee.[2] The best and latest authorities can be quoted to the same effect as to man. M. Willième says "it has caused death when neither the prudence nor care of those who administered it could be called in question."[3] Richardson uses the same words, and continues, "we must, therefore, look for the cause of death in some inherent fault in chloroform itself, which unfits it for every person indiscriminately."[4] Kappeler says that "men, as well as the animals of the experimental physiologist, succumb to chloroform, and that *the fatal dose is a very variable one.*"[5] Lallemand and Perrin state that "observation has demonstrated that *the regular sequence of events which occurs in animals is not followed in man.*"[6] Later, M. Perrin said that the danger and death from anæsthetics "result from accidental perturbations of the great functions, *which are not in direct relation to the progressive action of the agent.*"[7] All these are but different words for the statement of the text, that there are "deviations from the usual order in which the various functions of the nervous system are affected by chloroform," and every one of these quotations is from a special friend and champion of chloroform.[1]

For skilful administration of anæsthetics the qualifications are, a thorough knowledge of the physiological and pathological action of these agents, derived from careful study, some experience, and the same mental qualities required for the use of the knife—confidence and boldness, tempered by caution. If the different modes in which danger makes its approach be well understood, rashness or carelessness will be duly checked, while, next to over-boldness, nothing is worse in administration than timidity. By this the dangerous stage of excitement is prolonged, the body becomes saturated with the agent before the nervous system is sufficiently affected, and the patient thus placed in the worst possible condition for a prolonged operation or for recovery from an accident with the anæsthetic.[2] It is needless to say that the administrator should devote undivided attention to his duty, and allow nothing to divert him from it. The junior surgeon when giving the anæsthetic should feel that his office is quite as important, if not so brilliant, as that of the operator, and he may be assured that by a skilful administration he will be certain to obtain from his seniors that recognition which is one of the surest stepping-stones to professional advancement.

The state of the atmosphere as to temperature and moisture in relation to the action of chloroform deserves a consideration far beyond that which it has as yet received. Although these conditions are but partially under our control, yet their modifying influence should be understood. At 40° F. air will contain and carry six per cent. of chloroform vapor, at 65° fifteen per cent, at 85° thirty per cent.[3] Thus there is an immense difference between an administration at the ordinary temperature of a dwelling in winter and on one of the hot days of summer. Animals submitted to chloroform vapor at 40° F. become anæsthetized but slowly, and only after marked and violent struggling; they also recover but slowly. At 80° the process is rapid, without excitement, and the recovery equally rapid. "A temperature of 70° is good for chloroform administration; all below 65° decidedly bad."[1] The same is true of a moist atmosphere, and in a hospital the hygrometer should always be consulted and fires ordered as necessary. "Whenever the dry and wet bulb differ less than five degrees the air is not sufficiently free of moisture."[2]

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[1] Commercial Hospital, Cincinnati, Clinic of Dr. Thos. Wood, Cin. Lancet and Observer, 1871.]

[2] British Med. Journ., June 21, 1879.]

[3] Congrès Inter., Bruxelles, 1875.]

[4] Med. Times and Gaz., May 28, 1870.]

[5] Page 120.]

[6] Traité d'Anæs. Chir., p. 131–2.]

[7] Congrès Int., Bruxelles.]

[1] Except, possibly, Dr. Richardson, and he is certainly not an enemy to it.]

[2] "If the animal shall have ceased to breathe within four minutes, I can ensure, in five cases out of six, resuscitation. But if an animal remain in even less vapor for seven minutes before respiration ceases, I cannot ensure recovery in more cases than one in six." Richardson, Med. Times and Gaz., May 28, 1870.]

[3] Snow, p. 34; Sansom, p. 22.]

To give a dose of spirituous liquor shortly before the administration begins is good practice, and if the patient be weak or exhausted from loss of blood it should invariably be done. When opportunity is afforded for regulating the matter, but a light meal should be permitted, and that not nearer than two or three hours before the anæsthetic is given. A full stomach is dangerous from its interference with respiration, and from the liability of entrance of pieces of food into the air-passages during vomiting, a mode by which death has been caused several times. Plates of false teeth should be carefully looked for and removed; they have caused disaster, and there have been many narrow escapes.[3] The patient should be in the recumbent position, whenever possible, and all clothing about the neck and waist loosened. The mental condition demands as careful attention as the body. For the administrator the process may have been so frequently repeated as to be of little consideration; to the patient, however, it is of momentous interest, and may be invested by the imagination with more terrors than really belong to it. A due appreciation of this fact will suggest, if a feeling of humanity should not, all the soothing and sustaining assurances possible. Let this be borne in mind as the patient passes under the influence of the anæsthetic. Talking should not be permitted, and especially remarks about the case or operation should not be made, for hearing is the last special sense abolished. Such plain dictates of common sense ought not to need statement, but the experience of life has furnished too many instances of the necessity for them.

As to the mode of administration, it may be said at once that all complicated apparatus, with valves to be watched, or to get out of order, should be rejected. Experience has demonstrated the fallacy of relying upon them for safety. Did death only occur from an overdose of the agent, an inhaler would afford absolute safety, but a large number of deaths have occurred when inhalers have been used, even with those ensuring absolutely correct proportions of the anæsthetic with air, while the administration has been by the simplest means in the vast majority of cases. A folded towel or napkin is everywhere present, and has been safely used tens of thousands of times. At the same time there are serious objections to this mode of administration, and they are not based on theoretical considerations, but on the sure foundation of physics. An equable and thorough admixture of the vapor with air is an essential requisite for safe and pleasant administration. It requires great care to ensure this with a towel; as the patient rolls his head about, the mouth and nose may be close to or removed from the spot upon which the chloroform has been poured, and thus too little or too much vapor be taken in with the current of air. A conical sponge, just large enough to cover the mouth and nose, and moistened in warm water, is a perfect instrument for the administration of chloroform, the liquid being carried to every part of it by a gentle squeeze; air must be thoroughly and equally mixed with the vapor as it passes through its pores. Moreover, one accident from carelessness can never occur with a sponge, for the patient cannot be deprived of a due supply of air by it, while many times the most dangerous symptoms and even death have occurred from the administrator becoming interested in the operation and letting the impervious towel fall down on the patient's face.

The administration should begin with very dilute vapor, the amount being gradually increased; the process should be regularly and steadily maintained, and the desired result attained neither too rapidly nor too slowly. The *dose* can only be a "clinical" one, as Perrin has stated. Twenty or thirty minims should first be poured on the sponge, and this gradually placed nearer to the air passages. If the patient coughs the vapor is too strong. The danger of great and violent changes in the strength of vapor inhaled, as when more liquid is added, has been shown, and irregularity of administration is pronounced highly dangerous by all authorities. The time occupied in the process, for an adult, and using general terms, should be five or six minutes. Too rapid an administration is highly dangerous, and one too slow is also faulty,—more remotely dangerous, and extremely unpleasant for both patient and operator. When the lifted arm falls as if lifeless, the patient is approaching the state of complete anæsthe-

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[[1] Richardson, Med. Times and Gaz., March 7, 1868.]

[[2] Ibid., May 28, 1870.]

[[3] Warren, Surgical Observations, with Cases, etc. Boston, 1867, p. 618.]

sia, and when the conjunctiva can be touched without causing winking, he has surely reached it. This test being satisfactory, and respiration going on regularly, as it does when "tolerance" of the anæsthetic has been reached, the administrator may then give the word to the operator that the patient is ready, and then only, for the dangers of partial anæsthesia are to be avoided.

The conditions which contra-indicate the use of chloroform are not numerous, but demand careful consideration.

There is abundant authority for the broad statement that if the patient be in such a condition as to allow the operation to be considered at all, no bodily disease he may have is sufficient to exclude the anæsthetic. Some pathological conditions, however, favor the deleterious influence of chloroform, and their existence renders especial care necessary. Of these, disease of the heart has always occupied the most prominent position. As concerns valvular cardiac disease the text is in agreement with all authorities. "So far from the man with cardiac affection being unsuited for the anæsthetic he is before all others the man who stands most in need of its protecting influence." Snow's case[1] of lithotrity, with observations of the heart's action in the same patient with and without chloroform, affords striking proof of the truth of this, and the statement may be extended to nearly all diseased conditions of the central organ of the circulation. Richardson considers as especially dangerous a weak and dilated right side of the heart, with varicose veins of the lower extremities and enlarged veins elsewhere. "In the body thus circumstanced, the right side of the heart is already half dead, and will readily succumb."[2] This agrees with the observation of the Anæsthetic Committee. When chloroform was substituted for ethidene "the right side of the heart began almost immediately to become distended and to be dark in color, and the activity of the heart rapidly failed."[3] Fatty degeneration of the muscular tissue of the heart has been accepted generally by the profession as a frequent cause of death, and as a satisfactory explanation of the fatal event whenever it has been found present on post-mortem examination. In Sansom's table, it is given as present 18 times in 56 cases; in Kappeler's, 16 times in 60 cases. The latter author admits the probability of a diseased heart giving way under chloroform more readily than a sound one, but does not accord to fatty degeneration the importance which has been generally ascribed to it. He believes that the anxiety to find an excuse for the anæsthetic has often magnified to large proportions a minimum of the condition. Moreover, of sixteen of his cases in which fatty degeneration was found eight had before, and some of them but a short time before, taken chloroform without dangerous symptoms. He expresses his surprise, also, that in 26 cases of amputation for senile gangrene, in which, besides calcareous deposits in the arteries and other affections of the heart, extensive and wide-spread fatty degeneration of the cardiac muscle was four times microscopically demonstrated, there was not in any case a single disturbing occurrence under chloroform; nor can he find a case of death from chloroform during any operation for senile gangrene, although this is a disease with which fatty degeneration of the heart is very frequently associated.[1] Kappeler, therefore, denies to this pathological condition the importance claimed for it, and is in accord with Snow, who gave chloroform many times when this condition was known to be present "in a very marked degree."[2]

While the earliest and the latest authorities agree upon this point, it cannot be denied that the presence of heart disease should militate strongly against the administration of chloroform, or forbid its use altogether. Whenever there is disease of the heart, or feebleness of cardiac action, ether or the mixed vapors should be preferred.

The influence of sex is noteworthy from the great preponderance of deaths in males, the proportion being more than two to one, while robust health and vigorous strength seem to increase the danger. Women bear chloroform better than men, and "the feeble bear it better than the strong.[3] This fact should have a bearing on the estimate accorded to army statistics of chloroform.

There is no age which contra-indicates the administration of chloroform. It has been given from the first day of life and to those in the nineties.[4] There is an entire unanimity of authorities in regard to the especial safety of chloroform for young children. It is vain, however, to look for any statistical basis for this opinion. Deaths have occurred in children from chloroform. The latest table compiled gives eighteen, four of them not

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[[1] Page 55.]

[[2] Med. Times and Gaz., May 14, 1870.]

[[3] Preliminary Report, Brit. Med Journ., Jan. 4, 1879.]

[[1] Page 122.] [[2] Page 54.]

[[3] Sansom, pp. 66, 67, 70: Snow, p. 50.]

[[4] The writer has given it to an infant twenty-four hours old for convulsions, to one five days old, for examination of the eye in severe ophthalmia, and to one forty-four hours old, for the incisions for hare-lip.

over five years of age.[1] As no record exists of the number of administrations to children, and not even an approximate estimate of them can be made, there can be no numerical foundation for the belief in the great comparative safety of chloroform for this class of patients. The immunity from accident they have enjoyed may possibly be explained by the general rule above stated as to the strong and the weak, by the great care sure to be exercised in administering so potent an agent to so feeble subjects, and the absence of that emotional state arising from dread of an operation, and the far milder stage of excitement or struggling in children. Farther use of the remedy is justified by the above, and by the fact that no death occurred in a child under five years of age previous to 1865.[2] Thus during seventeen years, when chloroform was in the highest favor and much more generally used than since, no death of a young child occurred.

Chloroform is especially dangerous to persons addicted to the use of alcoholic liquors in excess, and those who use chloral habitually are in no better category. The existence of delirium tremens contra-indicates the administration of chloroform except under the most pressing necessity.

The condition of albuminuria must be looked upon as one increasing the danger from chloroform, although most authorities speak of it only when uræmic poisoning affects the mental condition or causes a tendency to sleep. This subject will be referred to again in connection with ether.

The question of administering an anæsthetic, when the patient is in a condition of shock or collapse from an injury for which an operation is demanded, is one of great importance, and one upon which surgical authorities differ. An extreme degree of this condition, of course, forbids interference, but when the patient is recovering, or is in a state of partial shock, operation and anæsthesia come under consideration, and for neither can hard and fast rules be laid down. Each case will tax the surgeon's best powers of judgment. Gross,[3] Erichsen,[4] Holmes,[5] and Bryant[6] favor the administration during shock, the latter very strongly indeed. Gant[1] and Savory[2] dissent. Mr. Holmes thinks ether the preferable anæsthetic in this condition; so also does Ashhurst,[3] who advises a tentative administration with careful observation of the effect. There can be no question that for operation upon a patient in shock of any degree, an anæsthetic should be chosen more stimulating to cardiac action than chloroform.

During administration the approach of danger will be indicated by the countenance of the patient, the respiration, and the pulse; these should all be watched. Difficult breathing, with dusky face and purple lips, are tokens of asphyxia; sudden and marked paleness indicates immediate and great danger. Sudden dilatation of the pupils, unless the patient be vomiting or awakening, is a symptom of extreme importance. Changes in regularity and freedom of respiration are easily observed. The pulse must be watched; irregularity and failing strength often precede collapse, and have been, in numerous instances, the first and only symptom to indicate danger. In twenty-one cases of dangerous symptoms by Anstie, in sixteen a change in the pulse is most prominently noted, and, with pallor, was the first symptom.[4]

Efforts to vomit are frequently made by the patient during the administration. They belong to the period of partial anæsthesia, and, if the stomach is known to be empty, they may be practically disregarded. If, however, the stomach be full, vomiting should be encouraged by irritation of the fauces, and the patient placed in such a position as to ensure escape outward of the contents of the stomach. For shouting and singing, and, in the female, hysterical symptoms, such as laughing or screaming, steady pushing of the anæsthetic is the most effective remedy. When violent and irregular muscular action occurs, only sufficient restraint should be used to keep the patient in position; firm holding will only render the spasmodic action worse. When the respiration is much embarrassed, or the chest muscles become fixed by tetanic contraction, great care should be exercised; breathing is often resumed with a long and deep inspiration, the danger of which, when the air is loaded with chloroform vapor, has been fully shown. A little time should be given to allow absorption from

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[[1] Turnbull, Manual of Anæsthetics, p. 109.]

[[2] Sansom's table, p. 67.]

[[3] System of Surgery, vol. i., p. 562.]

[[4] Science and Art of Surgery, Phila., 1869, p. 45.]

[[5] A Treatise on Surgery, Phila., 1876, p. 130.]

[[6] Practice of Surgery, London, 1876, vol. i., p. 251; vol. ii., p. 538.]

[[1] Science and Practice of Surgery, Phila., 1871, p. 235.]

[[2] See vol. i., p. 156.]

[[3] Principles and Practice of Surgery, by John Ashhurst, Jr., 2d ed., Phila., 1878, p. 136.]

[[4] Sansom, pp. 87–9. Well-marked cases in proof may be found in Kappeler, pp. 63–4; Phila. Med. Times, March 15, 1879.]

the "supplemental air" in the lungs, a few inspirations of pure air allowed, then gradual resumption with very dilute vapor, will tide the patient over the stormy and threatening period. Slapping with a wet towel will often prove effective in producing respiratory acts previous to the entire abolition of sensibility and reflex impressions.

For more imminent danger the surgeon should be prepared as he is prepared to meet hemorrhage, or any other unexpected event of an operation, and the same knowledge, coolness, and promptitude of action will serve both himself and his patient in the one case as efficiently as in the other. Danger and death approach by more than one route, and the treatment should be adapted to the symptoms presented. Nevertheless, the measures which experience has shown to be most reliable and effective are not numerous. The first step is to ensure free passage for the air to and from the trachea by removing all obstruction on the part of tongue, palate, or epiglottis. This may be effected by pulling the beard or a fold of skin below the chin so as to draw forward the inferior maxillary, and with it the tongue, as directed in the text. Indeed, Howard maintains that a free passage is so well secured by this measure that pulling out the tongue is unnecessary; that by lifting up the lower jaw, combined with extension backwards of the head and neck, the epiglottis is more surely elevated than by traction on the tongue.[1] The head should certainly not be lifted up or bent forwards.

This measure proving ineffective, or without it, the tongue should be pulled out, and there can be no doubt of the importance of the doctrine of the text that when this is resorted to it should be thoroughly done. Kappeler states that his experiments on the cadaver have convinced him that the epiglottis is not raised until the extension of the tongue is sufficient to elevate the hyoid bone and inferior maxillary.[2] There is good evidence, also, in support of the text, that pulling forward the tongue does not act merely mechanically, but also "through the nervous system." Thus, four patients have been rescued from great danger by titillations of the fauces. Each excitation of the throat was followed by an inspiration. In addition, experimental physiology has demonstrated "that the isthmus of the fauces is the last refuge of sensibility during the ultimate period of anæsthesia."[1]

Should the evidence of obstruction in the air-passages be marked, and especially when there has been vomiting of undigested food, tracheotomy should be instantly performed. Cases have been thus saved by Broadbent, Langenbeck, Sachs, Marshall and Clover, Howse,[2] and others.

When sudden failure of respiration or circulation, or both, occurs, the body and legs of the patient should be lifted up, and the head allowed to hang down. This measure, known as "Nélaton's plan,"[3] was suggested by observation of its effect

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[[1] Brit. Med. Journ., May 25, 1878. The effectiveness of the process, as shown on the cadaver, is attested by Thos. Bryant, C. Hilton Fagge, and F. A. Mahomed.]

[[2] Page 126.]

[[1] Lallemand and Perrin, Traité d'An. Chir., p. 496.]

[[2] Kappeler, p. 132; Brit. Med. Journ., Oct. 26, 1878; Am. Journ. Med. Sci., April, 1861.]

[[3] Nélaton published his observations in 1861, having taught the plan for some years previous in his lectures. It was introduced to the notice of the profession of England and this country in 1874, by Dr. Marion Sims. That Nélaton was the sole originator of this mode of treatment has been denied, and made the subject of acrimonious discussion. Dr. Schuppert, of New Orleans, published it in the New Orleans Med. and Surg. Journal, Jan., 1875, and claims that he used it ten years previously without any knowledge of Nélaton's suggestion. Dr. E. C. Holmes, of Chicago, published the plan of lowering the head for chloroform-accident in the Medical Journal of that city, for Sept., 1868, and also claims that he knew nothing of its proposal by any one else. Finally, Dr. Hunter McGuire, of Richmond, Va., has furnished written testimonials to the writer from several gentlemen who held prominent official positions in the Confederate Army, stating in most positive terms that it was known, and always practised in field hospitals during the war, and as early as 1861, and that it was not connected with the name of Nélaton or any other person as originator. The origin was doubtless with Piorry (Mémoires, Paris, 1831); quoted by J. B. Rottenstein, in Traité d'Anæsthésie Chirurgicale, Paris, 1880, p. 190. His experiments with animals showed the great efficiency of this plan of inversion in restoring them from syncope after hemorrhage. "Syncope" being in France the one recognized expression of chloroform accident, it was but natural that Nélaton should apply this remedy to this condition. But since cerebral anæmia was a matter of observation, published in this country as early as 1860, there could not be much difficulty in making application of physiological and pathological facts to so striking a condition as chloroform collapse, and one so urgently demanding relief. Nor can there be the slightest violence to probability in assuming that the plan originated with several persons at once. Priority of publication, however, justly attaches Nélaton's name to it.]

in resuscitating animals, and has proved effective in human beings upon many occasions. Koch, of Berlin, alone among authorities, challenges its soundness, and speaks of its basis as "a hypothetical and questionable cerebral anæmia." Yet nothing in medicine has a surer foundation than the doctrine that cerebral anæmia is a condition of profound artificial anæsthesia. It has been demonstrated in animals by Carter,[1] and by Bernard,[2] and has been a subject of observation in a case of accident.[3] But theory may be laid aside; the only question is as to its clinical value, and upon this point the affirmative evidence is abundant. In Nélaton's first case, given to the profession of this country by J. Marion Sims, failure of pulse and respiration occurred three times, and were each time restored by inversion of the body. M'Cormack had a similar experience.[4] Kappeler[5] gives a striking instance in a child fifteen months old. He observed a change of color in the face immediately after the patient was inverted, but the first spontaneous feeble inspiration was made only after artificial respiration had been continued two or three minutes. By perseverance in this and other measures the patient was restored, the operation completed, and the child placed in bed, when collapse again set in with the same dilatation of pupils, paleness of face, and cessation of respiration as before. Immediate inversion of the body brought about speedy recovery without resort to any other procedures. This measure then rests securely upon experiment upon animals and clinical experience. Nevertheless, it should be judiciously executed; rough and violent movements are decidedly injurious to a patient in this critical condition. Richardson emphasizes the deleterious influence of handling or moving the bodies of deeply narcotized animals, and says that all chance of recovery is thereby destroyed, and that this holds good of chloroform narcosis, and for the human subject.[6] The clinical evidence in favor of inversion of the body was not, at the time he wrote, more than a fraction of what it is now. Nevertheless the deleterious influence of such movement of the body has been recognized by others. Lallemand and Perrin call attention to the fact that death has occurred three times immediately after and apparently in consequence of change of the patient's position,[1] and Willième notes the same fact as to four or five cases.[2]

Simultaneously with inversion, and continued afterwards if it has failed, artificial respiration should be carried on. This is in theory the most reliable, and has proved by innumerable experiments upon animals and in practice the most efficacious remedy. Of twenty-two cases of rescue given by Sabarth, artificial respiration was the most prominent means used in eighteen.[3] The air-passages being maintained patent, the process should be faithfully, steadily, and gently persevered in. Animals are often restored after forty minutes, and in one case of chloroform accident the first observable cardiac and respiratory movements took place only after it had been continued for thirty minutes.[4] In another it proved successful after twenty-two minutes.[5] Dr. Emmet rescued a case by this means after a perseverance of thirty-five minutes.[6] It is not limited to those cases in which respiration alone fails; the functions of respiration and circulation are too intimately connected, and the influence of the former in maintaining cardiac action is a well known physiological fact, and must have been observed by every practitioner as he has resuscitated an infant after a severe delivery.

As to the mode of effecting artificial respiration Sylvester's is the best. It is the most effective,[7] and from the position of the patient, and the small amount of bodily motion required to carry it out, is peculiarly adapted to chloroform cases. Restoration has in several instances followed upon artificial respiration after tracheotomy, when it had proved ineffectual before.

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[1] Wood's Therapeutics, p. 248.]

[2] Leçons sur les Anæsthésiques, etc., Paris, 1875, pp. 114–122.]

[3] Am. Journ. Med. Sci., Oct., 1860, p. 399.]

[4] Brit. Med. Journ., Aug. 22, 1877.]

[5] Page 135.]

[6] Med. Times and Gaz., May 14, 1870.]

[1] Page 410.]

[2] Congrès International, Bruxelles, 1875.]

[3] Das Chloroform, Wurzburg, 1866, pp. 172–6.]

[4] Koch.]

[5] Dublin Journ. Med. Sci., Nov., 1872.]

[6] Letter to the writer. Another eminent gynæcologist sends a brief report of a case in which artificial respiration proved effectual after inversion of the body had failed. No names are given, because there was evident mal-administration; the handkerchief was kept to the nose and mouth after the patient was snoring. "Six days since I was circumcising a boy two and a half years old. He died, *i. e.*, there was no breathing, and not a particle of heart action. I held him up by the feet, head downwards, put in force Marshall Hall's method, dashed cold water in his face and all. No life, he was limp as a rag, every minute an age. Finally I placed him on his back, held his nostrils, and with my mouth over his inflated the lungs, and then compressed the chest. He gasped and finally came around. It was a resurrection!"]

[7] For proof see report of Comm. of Royal Med. Chir. Soc., in Am. Journ. of Med. Sci., Oct., 1862.]

Traction of the tongue, inversion of the body, and artificial respiration, these are the great remedies in accidents from anæsthetics; they are immediate in action, always at command, and easy of application. Some others deserve mention, and at the head of the list is electricity, the practical difficulties of which under the circumstances are apparent. It is solely as a means of exciting action in the inspiratory muscles that it deserves consideration. For this purpose it is not favored by Perrin,[1] nor by Richardson.[2] The latter calls it a "two-edged sword," liable to do positive injury by rapidly exhausting the contractility of the muscles upon whose action restoration to life depends. Nevertheless in Vulpian's hands it proved very efficient in resuscitating animals, one pole being applied to the face and one to the base of the chest. It has proved efficacious in many cases of collapse from chloroform, upon the testimony of Ziemssen and others. Sabarth gives a case[3] in which it was successful twenty minutes after the dangerous symptoms began, and after various other measures had been tried in vain, among them artificial respiration by methodical compression of the chest.

The following directions for applying this remedy are abbreviated from Beard and Rockwell's Treatise on Medical and Surgical Electricity.[4] The shoulders and arms of the patient should be fixed; the current used should be strong enough to produce vigorous contractions in the muscles of the ball of the thumb; the electrodes, of large size and well moistened, should be pressed firmly over the phrenic nerves at the outer borders of the sterno-mastoid muscles, and at the lower end of the scaleni muscles. The electrodes should be removed several times a minute, and pressure made on the abdomen to insure expiration.

Atropia is a most powerful respiratory and cardiac stimulant; rapid in action, and by the hypodermic method readily introduced; its reaching the nervous centres governing these functions, in cases where the circulation is reduced to a minimum must, however, be considered problematical. There is no question that it should be administered if at hand, but its action as a preventive of accident is without doubt more reliable.

Nitrite of amyl has received the highest commendations as a means of combating chloroform narcosis.[1] Its administration being by inhalation of the vapor, it can only be resorted to in some cases. Recoveries have unquestionably followed its use, but whether as a sequence or a consequence is not so clear, and farther observations are needed. It must be remembered that although nitrite of amyl is a most effective remedy in one form of cardiac disease, its brilliant service is not due to its action on the heart, but upon the peripheral arterioles, spasm of which it relaxes,[2] and that its action in lowering the blood-pressure is not favorable to its use in chloroform accidents.]

Various attempts have been made during the last nine years to improve our anæsthetic methods. Among these must be mentioned the reassertion of the claims of sulphuric ether by the late Dr. Mason Warren, of Boston, in America. Our transatlantic brethren naturally feel indignant that their grand discovery of anæsthesia in surgery should be confounded with the very secondary matter of finding out that a different agent from that which they employed will produce similar effects in a more efficient manner. For the introduction of chloroform when the whole subject was a novelty, led to a confusion in the public mind in this country, where "the discovery of chloroform" is often regarded as identical with the discovery of anæsthesia. And there can be no doubt that if sulphuric ether were still in use in Britain as it is in Boston, and if chloroform were now brought forward for the first time as a substitute for it, comparatively little would be thought of the innovation. More convenient chloroform undoubtedly is, on account of its smaller bulk, and the greater facility of its administration. But Dr. Warren contended that these advantages were more than counterbalanced by the greater safety of ether, which he declared had never up to the time of his writing produced a single death.[3] Admitting the facts to be in the main as Dr. Warren has given them, the case may probably be fairly stated by saying that ether, being less potent, is less liable to cause death from mismanagement. But the rules for the satisfactory use of chloroform are so simple that mis-

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[[1] Traité de Anæs. Chir., Debate in Congrès International, Bruxelles, 1875.]

[[2] Med. Times and Gaz., July 23, 1870.]

[[3] From Prakt. Arzt., 1860.]

[[4] Second ed., New York, 1879, p. 664.]

[[1] The National Dispensatory, Stillé and Maisch, p. 166.]

[[2] Fothergill, Handbook of Treatment, 2d ed., Phila., 1880, p. 351.]

[3] See Surgical Observations, with Cases and Operations, by J. Mason Warren, M.D., etc.

management is really inexcusable; and if we had nothing else to consider than the question of safety, chloroform would probably in all cases maintain its superiority over ether. There is, however, another point in which a great advantage has been lately claimed for the original anæsthetic. The vomiting which is so frequent after chloroform is generally only a matter of more or less inconvenience. But in the special case of ovariotomy the disturbance of the abdomen thus occasioned is often a cause of death. Dr. Thomas Keith, whose remarkable success in that operation is well known, was led to try sulphuric ether in the hope that it might prove less objectionable in this respect; and the result has been in the highest degree satisfactory, so that whereas with chloroform vomiting was the general rule, it now seldom occurs in his practice.[1] Dr. Keith has also ascertained that if truly anhydrous ether be employed, it can be given so as to produce its effect almost as rapidly as chloroform, and without waste of the material, by simply pouring a little of the liquid occasionally upon a piece of flannel contained in a cup-shaped vessel adapted to the mouth and nose, with a small aperture for the entrance and exit of air. Hence, as there are various other operations in which the avoidance of vomiting is a matter of great moment, sulphuric ether seems likely to reassume an important place as an anæsthetic.

[During the period which has elapsed since the above appeared, ether has made a great advance in professional favor at the expense of chloroform, in this country as well as elsewhere. It may be safely said that the fact of its American origin has had but an insignificant, if any, influence in effecting this change. Heavily weighted by great practical disadvantages, ether has steadily gained in the race with chloroform solely on account of the increased and stronger evidence of its greater safety. The early years of the decade just closed were marked by a startling increase of accidents from chloroform. One British journal published the details of seventeen deaths between January 1, 1869, and July 1, 1870. Another recorded twenty-five in a single year.[2] These unfortunate cases forced a recognition of the dangers of chloroform, and turned the attention of the profession to the superior safety of ether, which had long before been distinctly stated—as by Snow, in his work in 1859, and by the Chloroform Committee of the Medico-Chirurgical Society in 1864. Able advocates of the superior safety of ether appeared, notable among whom were Mr. Morgan, of Dublin, who estimated the chloroform deaths in Great Britain as one per week,[1] and Dr. B. Joy Jeffries, of Boston, to whose powerful plea at the Ophthalmological Congress of 1872 Kappeler attributes great influence. The reaction which then began marked the opening of a contest between the two great anæsthetics which is not yet closed.

That ether is safer than chloroform cannot be proved by statistics; the degree in which it is safer cannot be stated even approximatively in figures. The statement of Mr. Morgan that it is eight times safer is but an estimate based on estimates. Reason, experiment, and clinical experience concur, however, in furnishing the most satisfactory proof. Ether is so much less potent a remedy than chloroform that danger of death by mismanagement is almost impossible, as stated in the text. For the same reason it cannot produce those sudden deaths by reflex action from a powerful influence upon the air-passages, as chloroform has been shown often to do. The testimony of experimental physiologists is unanimous as to the frequency with which animals die when chloroform is used as compared with ether, the heart suddenly and unexpectedly ceasing to act. The testimony of the Anæsthetic Committee, as the latest and best authority, need only be adduced upon a point so strongly supported as this: "Ether may be given (to animals) for an indefinite period without interfering with the heart."[2] Finally, the concurrent experience of the profession may be adduced. Ether is now used exclusively in at least one-third of the hospitals of Great Britain, and a mixture of ether with chloroform in nearly another third, while there is shown a general disposition of the profession throughout the United Kingdom to abandon the one for the other.[3]

The same action has been taken by the profession throughout the greater part of this country. In order to obtain accurate information as to the relative use of chloroform and ether, and some other facts in regard to anæsthetics, the writer issued a circular to the profession, and from the replies received the following statements are made:[1]—

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[1] See The Lancet, August 20, 1870.

[[2] Debate in International Congress, Brussels, 1875.]

[[1] Dublin Journal Med. Sci., Nov., 1872.]

[[2] British Med. Jour., Jan. 4, 1879.]

[[3] W. D. Bizzell, M.D., of Mobile, Ala., in Virginia Med. Monthly, Aug., 1879, from a paper read by Dr. Jones before the Cork Med.-Chir. Association.

About the same statement is made in the British Med. Journ. for Nov. 6, 1880, with the following statistics: Deaths from chloroform reported by leading English journals, in 1876, 10; 1877, 12; 1878, 13; 1879, 8; 1880, to Nov. 1, 20; total, 63. During the same time, the same journals contained reports of ten deaths from ether, five of them in England, two of the ten from pulmonary affections causing death some hours after the administration.]

Some strongly-marked geographical lines can be drawn in this country in regard to the use of the two anæsthetics.

Thus, in all New England, of fourteen surgeons, not one uses anything but ether.

Taking next the cities of New York, Brooklyn, and Philadelphia, containing together about two and a half millions of inhabitants, and which may be classed together from their proximity and similar metropolitan character, in these cities there are thirty-six surgeons who use ether, three who use ether or chloroform indifferently, and only two who declare that they use only chloroform.

The remainder of the country may be divided into two sections, North and South, by a line running on the boundary between Maryland and Pennsylvania, along the Ohio River, and thence directly west. These sections present a striking contrast as to the use of anæsthetics. In the North thirty-seven surgeons use ether, twelve use chloroform, and seven either indifferently. Four use a mixture of the two; two the mixture of alcohol one part, chloroform two parts, ether three parts; one a mixture of one part chloroform to three parts ether, and one a mixture of one to two.

In the Southern section of the country twenty surgeons use chloroform and twelve ether. One uses the mixture of one to three, and two use the alcohol-chloroform-ether mixture "frequently when ether fails."[2]

In regard to abandoning the use of chloroform for ether, taking the whole country together, forty surgeons, or about thirty per cent., have made the change within ten years, and nine more within about fifteen years. Five have changed from ether to chloroform, giving as a reason the superior practical advantages of the latter. In the majority of cases the reason given for changing from chloroform to ether is death or dangerous symptoms observed in patients under chloroform. Quite a respectable percentage, however, give only the "influence of professional opinion" as the determining cause.[1]

One hundred and forty-four surgeons report that they had seen thirty-four deaths from chloroform and eight from ether,[2] one of the latter having been from obstinate vomiting afterwards.

Dangerous symptoms from chloroform are reported as having been witnessed two hundred and thirty-one times, while twenty-three surgeons use the indefinite term "several times," and six more say "frequently" or "repeatedly."

Dangerous symptoms from ether are reported as witnessed fifty-six times, while "several" is used seven times, and "frequently" or "often" six times more. Four gentlemen write of bronchial or pneumonic troubles following the administration of ether, and one writes of two deaths in his practice from comatose symptoms coming on a few hours after the administration, both patients being in advanced age—one about 70, the other 80.

In justice to chloroform it should be

[[1] It would be manifestly impossible to reach in this way any very considerable proportion of the general profession. With few exceptions only those were addressed who are surgeons, and those who by official position in hospitals or medical schools may be considered, in a measure, representative men.

[[2] Is it not possible that *climate* will yet be found to exert a considerable influence upon the choice of an anæsthetic? Two or three correspondents express the belief that it plays an important part in determining the relative mortality, and Richardson's teachings as to temperature and atmospheric moisture suggest an affirmative answer.]

[[1] As instances of change of anæsthetic agents after long use without serious accident, the following quotations from replies to the circular may be made. From the high standing and long experience of the writers, they may serve as examples of the strength of this current of opinion:—

"I have employed anæsthetics ever since their introduction. For many years I employed nothing but chloroform in its pure state, and have never met with a fatal accident, although on several occasions symptoms of a very alarming character arose, and that even when the greatest possible care in its administration was observed. During the last few years, I have used ether more frequently than chloroform, first, because it is *unquestionably* a safer agent; second, because I have become more timid in regard to other anæsthetics, and, lastly, because professional and public sentiment is decidedly arrayed against chloroform."—S. D. Gross.

"I commenced the use of anæsthetics by a combination of ether, three parts, chloroform one part. This was in the year 1853, and I continued the use of this combination for nearly twenty years, not only in ovariotomy, but in general surgical practice. About 1870, so many accidents were reported in the medical journals from the use of chloroform, that I adopted a different course. I first use Squibb's ether, and when any difficulty arises in getting the patient sufficiently anæsthetized, I supplement it with chloroform. I have never had any dangerous symptoms from this plan, and expect to continue it."—Jno. L. Atlee.]

[[2] More than one surgeon may have witnessed and reported some of the deaths, but no hearsay cases have been admitted.]

stated that the inquiry has discovered some most enthusiastic friends and developed some strong testimony in favor of it. Thus, Dr. Hunter McGuire, of Richmond, Va., states that in the division of the Confederate Army to which he was attached, it was administered 28,000 times without a death. Dr. D. W. Yandell, of Louisville, has used it during thirty-two years, and estimates the number of administrations in army and private practice at 10,000, with no death, and dangerous symptoms but once, when there was evident faulty administration. Dr. J. J. Chisolm, of Baltimore, gives the same estimate, likewise from army and private practice, without a death. But two or three surgeons outside of the Southern States express any enthusiasm in favor of chloroform.

But although ether is unquestionably a safer anæsthetic agent than chloroform, it is not absolutely safe. It has its necrology as well as chloroform. Denial of this is frequently made, just as the friends of chloroform deny any death from that agent except as the result of mismanagement. But the proof of death under ether, caused by the ether, is abundant and irrefragable. The first accident occurred as early as 1847,[1] and was plainly the result of the anæsthetic; others have been recorded from time to time since then, and within the last decade. Coincident with a greatly increased use of ether, they have appeared much more frequently. The statements at the Congress at Brussels that fourteen deaths from ether were known, and that it had caused eleven deaths in Lyons alone, were not denied. But the case does not rest on indefinite statement. The details of all the cases of death recorded for ten years were published in 1878,[2] and of these there were nine cases in which "ether appeared to play no secondary part, nor even to be assisted by any untoward condition or circumstance." Kappeler collected thirteen cases, published between 1872 and 1878, of which ten present no extenuating circumstances. Since then others have appeared, and the following may be given as a sample:—

Case.—Male, age 66; obstruction of bowels; given for colotomy; two ounces put in Clover's small inhaler, one ounce used. Heart examined and found healthy; no contra-indication existed. After ten minutes pulse was beating strongly, he vomited once a little dark fluid, smelling of brandy, took one deep inspiration, and quietly died.[3]

Case.—Male, age 62; addicted to drink. Ether given for examination of hips injured the day before, patient being in good condition. Two ounces of whisky given, then ether administered to amount of three or four ounces. Patient never fully anæsthetized, pulse carefully watched. At a period not later than fifteen to twenty minutes from beginning of inhalation, "the patient suddenly, and without any symptomatic warning whatever, stopped breathing, and was dead.[1]" "Death was instantaneous," another observer writes. Post-mortem examination showed pleuritic adhesions, heart full of dark fluid blood, its muscular structure healthy, the valves, especially the aortic, affected with atheromatous deposit, liver and kidneys congested, the latter studded with cysts. Verdict of coroner's jury, "The deceased came to his death from causes unknown to the jury, while under the influence of ether."

There are two facts in regard to the action of ether not generally recognized, yet of the highest importance. The first is, that ether, in the human subject, may produce death as suddenly, as unexpectedly, and in the identical manner that chloroform does. That this statement does not apply to the lower animals, is the concurrent testimony of all experimental physiologists. When experiment on animals and clinical experience concur in sustaining a position, it is impregnable; when they clash, the latter must carry our convictions, because it is the last authority, one from which there can be no appeal. If belladonna were administered to man, in accordance with its effects on animals, the results would not be curative or pleasant. The clinical proof that under ether heart and respiration both stop simultaneously, or that the heart may even stop first, is abundant.[2]

[[1] Traité d'Anæsthésie Chir., p. 250.]

[[2] By Mr. Cawtley Dawson, of Leeds, Brit. Med. Journal, March 2.]

[[3] London Lancet, Sept. 4, 1880.]

[[1] Unpublished case, from a surgeon in New England. The gentleman is sued for $10,000 damages for the misadventure!]

[[2] No one could have a deeper respect for the memory of Snow than the writer, for he was witness to his industry and his enthusiasm, and to him he owes not only instruction, but an enduring inspiration. Yet his book contains so striking an instance of the false logic upon this point, that it cannot be passed by. It is in regard to the second case of death from ether which occurred at Lyons in 1852. Pulse and breathing stopped all at once. Snow says she died from hemorrhage, yet nothing is said in the original report of hemorrhage, except that two vessels were tied, the operation being for removal of superior maxillary, and these were tied before the ramus was divided. He adds, "according to the result of my experiments on animals, *ether is not capable of causing the kind of death which this patient died.*" The reasoning is that the patient could not have died in that way because no animals had thus died.]

Case.—Female, age 48, healthy in appearance and tolerably robust. Fifteen grams of pure ether given by an inhaler, for extirpation of cancerous mammary gland. Patient in good spirits and confident. Fifteen grams of brandy given before administration. During the inhalation she held the doctor's hand, and called him by name when consciousness was partially lost. Soon there was turgescence of the face, and the pulse was not to be felt. Some deep inspirations followed the means of resuscitation, but they became gradually weaker, and she died in fifteen minutes from beginning of the administration. The post-mortem showed some cancerous nodules in the lungs.[1]

The details of many cases in which death was narrowly escaped show the same. Kappeler gives three, in all of which pulse and respiration suddenly and simultaneously failed. In one of them, at Guy's Hospital, the patient, a boy eleven years old, artificial respiration was maintained for four hours, during all which time the pulse remained extremely feeble.

In addition, the opinion of the highest authority may be adduced. At the International Congress at Brussels M. Perrin said: "The fact of death from ether cannot be contested, and the accidents, whatever may be said, resemble those from chloroform. Like chloroform, ether exposes to sudden accidents, impossible to foresee, dependent on accidental syncope." M. Forget said, that "to deny that *every anæsthetic* causes sudden death is to refuse to receive evidence." Kappeler, in summing up the evidence furnished by his table of ether deaths, says: "From the foregoing facts, however, it by no means appears that ether-death in man is essentially different from chloroform-death, nor that death under the inhalation of ether in man always commences by disturbance of respiration, and in every case proceeds from the respiratory organs, as experimental physiologists maintain to be the case with animals."

We are forced, then, by clinical evidence to reject the statement of text-books, that ether "*never* suddenly paralyzes the heart," as well as the latest doctrine that ether always gives warning by the pulse, it becoming "weak and slow, not suddenly but gradually."[2] Nor will the doctrine of Schiff, based wholly upon experiment with animals, that death under ether always begins with the respiratory function, bear examination by the light of clinical experience, while his corollary that the surgeon is always responsible for the death of a patient under ether, is unsound, as it is sure to work, if adopted, most serious injury and great injustice to whoever may be so unfortunate as to have an accident with this anæsthetic.

The second important fact in regard to ether, is that the dangerous symptoms or death may supervene at some considerable time after the administration has terminated, just as they do after chloroform. Whether the fatal event can justly be attributed to ether in such cases as those reported by M. Richet,[1] where a suffocative catarrh began soon after the inhalation, and caused death some days afterwards, remains yet to be determined. There are cases fully detailed, however, exactly resembling those occurring after chloroform, and in regard to which there can be no question.

Case.—Female, age 35; thirty grams given by inhaler, for flexion of contracted knee. All went well until one hour and a half after the administration, when suddenly cyanosis, failure of pulse, and pulmonary rattling made their appearance, and death followed one hour and a half later.[2]

Case.—Male, age 19, with posterior spinal curvature; ether given for tenotomy and flexion of knee. Fifteen minutes after patient was removed to his room, he was suddenly seized with symptoms of asphyxia and failure of respiration. Death forty-five minutes later.[3]

The writer is cognizant of a number of such cases, in which the patient was rescued by vigorous measures, and which have never been published. It is probable that these late-appearing accidents are more frequent with ether than with chloroform, from the larger quantity required, its greater solubility in the blood-serum, and the slower rate of its excretion. With present knowledge they are the most inexplicable facts connected with anæsthesia.

The physiological action of ether, although in general closely resembling that of chloroform, differs in some points so much as to demand consideration. As in its mode of causing death the effect of ether upon the blood-pressure is far from showing in man that entire want of influence which it exhibits in animals, neither does it in man show that invariable and unexceptionable depression of pressure which is characteristic of chloroform. With chloroform, marked depression of the sphygmographic curve is always produced in man, while with ether a considerable proportion of cases show no change. Thus, Kappeler gives ten tracings, in three of which there was but slight, if any, change from the normal—an occurrence not presented once in twenty-five observations with chloroform; but in seven of the ten cases "the curve of deep ether-narcosis differed not at all from that of chloroform-narcosis."[1]

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[1] [Kappeler, from Brit. Med. Journ., Nov. 17, 1877.]

[2] [Boston Med. and Surg. Journal, Dec. 2, 1880.]

[1] [Accidents tardifs apres l'administration d'anæsthésiques, Gaz. des Hôpitaux, July 12, 1879. Four cases, 3 after ether, 1 after chloroform. Three of the patients very obese.]

[2] [Kappeler, from Brit. Med. Journ., Nov. 17, 1877.]

[3] [Dr. T. G. Morton, Amer. Journ. Med. Sci., Oct., 1876.

Deep flushing of the face occurs under the administration of ether. A profuse salivation is a very unpleasant feature, causing cough, efforts at swallowing, and choking sensations. The pupils are not generally so closely contracted as under chloroform, and may remain unchanged. The respiratory action very rarely goes on undisturbed with ether as it often does with chloroform; cough, hawking, catching of the breath are almost always present, and marked irregularity is the general rule.

In the length and severity of the stage of excitement there is the greatest contrast between the two agents. With ether irregular muscular action is extreme, and marked rigidity of the extremities, which may extend to the whole body; there are violent efforts to escape from the inhalation, prompted by the distressing sense of suffocation, and, more generally than with chloroform, there are struggles with the arms and legs, attempts to rise from the table, and even to get out of the room. The stage of relaxation and complete anæsthesia having been attained, it is maintained with difficulty; the patient readily relapses into a condition of excited intoxication, in which it is impossible for the operator to proceed. Finally, the return to consciousness is marked with more unpleasant symptoms than that from chloroform. A state of excitement like partial intoxication, and various hysterical symptoms are apt to make their appearance, while the smell and taste of ether may disgust the patient for hours if not days.

The question as to which anæsthetic causes vomiting most frequently afterwards, long undecided, may be said to be settled in favor of ether by the experience of Dr. Keith, of Edinburgh, whose brilliant success with an operation after which vomiting is especially deleterious is well known. There is no question, however, that this unpleasant effect of ether, as well as the stage of excitement, may be very much and very favorably modified by circumstances fully under control. The quality of the ether should be assured. The mode of administration is very important. When the patient is brought promptly under the influence, without saturating the tissues throughout the body, the stage of excitement is less marked, the subsequent vomiting more frequently absent or milder, and recovery from the anæsthetic state is more rapid and less unpleasant.

There can be no doubt that an examination of the urine of a patient should precede the administration of ether whenever practicable. Dr. T. A. Emmet, of New York, was the first to call the attention of the profession to this subject.[1] About sixteen years ago, in reporting a death after an operation for cystitis, he urged the greater necessity of examining the condition of the kidneys than that of the heart. Albuminuria being present indicates that the eliminative power of the kidneys is embarrassed, and under these circumstances the most unfavorable results are likely to follow the administration of ether. He states that he has had at least five deaths under these circumstances, which might have been avoided had the urine been examined. Further experience has sustained the correctness of Dr. Emmet's position, and other observers have called attention to the connection between diseased kidneys and death from ether.[2]

The importance of the mode of administration having been shown it may be said that for ether an inhaler is as advisable as it is unadvisable for chloroform. It is next to impossible to anæsthetize a patient by giving ether on a towel, as can be done with chloroform with dangerous rapidity.

There should be an enclosed space over the mouth and nose containing the vapor and a certain amount of air, and from which the air may be for a time entirely excluded. The administration may be effected by a cone of paper with a sponge in the apex, or a napkin rolled up, on the inside of which the ether is poured; but these are apt to lose their shape upon being wetted by the ether, and may become a source of danger. The end can be therefore more conveniently, more expeditiously, and more pleasantly attained by the use of an inhaler. Of these there are numerous patterns and devices. Kappe-

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[[1] Pp. 158–167.]

[[1] Gynæcology, 2d ed., p. 746.]

[[2] Case of death from ether, by Thos. G. Morton, M.D., Amer Journ. Med. Sci., Oct., 1876. Also Dr. Hunt, Philadelphia Med. Times, Feb. 6, 1875.

There is a curious observation by Mr. Lawson Tait, published in the British Medical Journal, Nov. 27, 1880, which seems to show a suppression of the urinary secretion under ether. This important subject should be fully investigated by skilful experimenters.]

ler praises highly Clover's lesser apparatus, which consists of a mask to cover the mouth and nose, an ether vessel, surrounded by a warm-water chamber, and a rubber sack, out of and into which the patient respires. There are no valves, but an arrangement exists by which the air can be shut off, and pure ether-vapor administered at pleasure. In using instruments of this pattern "anæsthesia and asphyxia proceed on parallel lines without, it appears, increasing the risk to the patient."[1]

Clover's apparatus is expensive, and not in our market. Any inhaler to meet the requirements of general practice must be inexpensive, simple, and easily managed. Such an instrument is Squibb's, described in Transactions of the Medical Society of the State of New York, and used in some public institutions. It can be made by any one. The inhaler designed jointly by Drs. Rohe and Leonard, of Baltimore, consists of a face piece and a rubber bag. These two inhalers are both of the "closed sack" character. Lente's smaller inhaler is a mask of sheet brass, with an opening for air which can be more or less completely closed by a perforated stopper. Allis's ether inhaler is an ingenious device for securing a large evaporating surface. For the mixed vapors it has rendered good service in our hands; for ether we should doubt if the air could be sufficiently shut off, but have had no experience with it for this anæsthetic. All these instruments meet the requirements above.

To attain satisfactory results in the administration of ether, it must be given boldly and freely. The young administrator may understand that all fear of too concentrated vapor, so just with chloroform, is needless. If continued too long, or too much be given, the danger will be from asphyxia, and no danger can be so readily avoided, because its approach is marked. The sudden deaths which have occurred under ether have not been shown to be connected, in the remotest degree, with any errors of administration. At first give but little vapor, so that the air-passages may become accustomed to it, the patient quieted and induced to breathe calmly and deeply. This attained, advance the strength of the vapor rapidly, and soon shut off the air as completely as possible. Air can never be entirely excluded by any of the inhalers. The closed sacks contain enough for several inspirations, and there is always some passage-way by the sides of the nose. A towel, wet with ether, falling down closely over nose and mouth, it is needless to say would be highly dangerous. Relaxation and complete anæsthesia having been obtained, a small quantity of air is to be admitted, but it requires careful watchfulness on the part of the administrator to prevent a partial return of consciousness, so embarrassing to the operator.

That an escape from the evils and inconveniences of the two great anæsthetics should be sought by using them in combination was but natural. A mixture of the two in varying proportions was proposed at an early day, but anæsthesia by this method has never obtained any great degree of general popularity, although in the hands of a few individuals it has been used with marked success. Snow was unfavorable to any combination of ether and chloroform, and against his influence even the strong recommendation of the Chloroform Committee did not avail. The statement of Snow, that from a mixture of the two agents there results "a combination of the undesirable qualities of both, without any compensating advantage," has not stood the test of trial. They have proved efficient, and as the committee stated, safer than chloroform. The mixture which has been most thoroughly tested is that consisting of three parts of ether and one of chloroform, known as the "Vienna mixture," and which is said to have been given in Vienna alone 8000 times without a fatal accident. Billroth adds to this now one part of absolute alcohol.[1] In this country this mixture was used for more than twenty years by two of the pioneers of ovariotomy without accident. Richardson says this is the best proportion for combined use, but gives no reasons for the statement. Next to this combination is the "alcohol-chloroform-ether mixture"—one part alcohol, two parts chloroform, and three parts ether, by measure. These mixtures were especially recommended by the Chloroform Committee as being "as effective as pure chloroform, and a safer agent when deep and prolonged anæsthesia is to be produced," and this particular combination "is to be preferred on account of the uniform blending of the ether and chloroform when combined with alcohol, and the equable escape of the constituents in vapor." Notwithstanding the latter clause, the objection is constantly urged that the rate of evaporation of the constituents is unequal and a source of danger. Allowing its force, all danger from this source can be averted by keeping it in view while conducting the administration. The other objection often urged that this mixture is not effective can be most positively denied; abundant experience has proved it to be "as effective as chloroform."

It is unfortunate that no means exist

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[1] [M. Perrin, Congress at Brussels, 1875.]

[1] [Kappeler, p. 200.]

by which the relative safety of these combinations of anæsthetics can be determined or even indicated. Deaths have undoubtedly occurred under all of them.[1] Dangerous symptoms under their use are mentioned in the correspondence, as having been witnessed sixteen times, and considering the comparatively few administrations, they have probably occurred nearly as frequently as under chloroform. At present, all that can be said decidedly in their favor is theoretical. As the chloroform is so much diluted it will not cause sudden death by reflex action, nor in any manner so frequently as when undiluted. On the other hand, it may justly be maintained, that the danger of these mixtures, as compared with ether, are increased in direct ratio to the amount of chloroform each contains.

The returns to the circular issued show that the mixed vapors are but very little used in this country. Several surgeons state that they resort to the alcohol-chloroform-ether mixture in place of chloroform for ovariotomy and other prolonged operations, and quite a respectable proportion of the adherents of ether virtually administer them, as they confess to adding "a little chloroform" whenever difficulty is experienced in bringing the patient under the influence of ether.[2]

With the present division of professional opinion as to the two leading anæsthetics, and with the present lack of accurate knowledge as to their relative danger, the young surgeon may feel considerable embarrassment in making a choice between them. It is possible also that the amount of attention here bestowed upon death and dangerous symptoms from them may increase his embarrassment as to a choice, or even shake confidence in both. Nevertheless, a full study of the dark side of anæsthetics, and a careful comparison of some current doctrines with recorded facts, seemed to be the plain dictate of duty here. If the claim that there is no risk in administering chloroform except that arising from mal-administration can be sustained, the proof should be advanced; and if the doctrines that ether only kills by interfering with respiration, or never kills at all are false, the facts should be presented, and if reason, experiment, and clinical experience concur in showing, as they certainly do, that ether is the safer anæsthetic, it should be set forth. Finally, if the truth be that all anæsthetics sometimes prove fatal in spite of the utmost skill, and care, and precaution—if "anæsthesia, *with any anæsthetic*, is sometimes the straw required to break the camel's back"[1]—the truth should be known and fully recognized, that those members of the profession who may be so unfortunate as to have accidents befall them with these agents may not be blamed, but held free from damage. The tone of professional opinion around the surgeon will of course strongly influence his choice. In case of accident from chloroform in some cities or sections, he would be unanimously condemned by his professional brethren; in others he would be sustained. But the choice, after all, will depend largely upon the decision of the question as to whether any risk ought to be incurred for the sake of convenience or practical advantages, and, if any, how much? The amount of relative danger not being yet exactly known, both anæsthetics being used by men of equally high position, ability, and experience, the choice must be matter of individual judgment, and made after careful study of the subject and conscientious consideration of the responsibility. If absolute safety in the use of anæsthetics cannot be guaranteed, the surgeon is in no worse case than he has always been in regard to other matters. Minor operations, even those of trifling import, sometimes prove fatal, yet such operations have never been avoided or declined, because in very rare instances and in a very small proportion they have been followed by the most serious consequences.

The action of anæsthetics can be most favorably modified by morphia. Given hypodermically to the amount of from one-sixth to one-third of a grain, some twenty minutes before the inhalation of chloroform, it diminishes the stage of excitement, lessens to one-half or even one-third the amount of the anæsthetic required, diminishes the vomiting, and promotes quiet sleep afterwards. This plan of mixed anæsthesia was first practised almost simultaneously by Nussbaum, of Munich, and Bernard the physiologist. It has now a very large amount of evidence in its favor.[2] There have been

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[[1] One by the alcohol-chloroform-ether mixture, and the only one thus far known, is recorded in Am. Jour. Med. Sci., Oct., 1876, p. 415. The patient had previously taken ether.]

[[2] The writer can give strong personal testimony in favor of the alcohol-chloroform-ether mixture, from use of it since 1864, which is worth no more than all individual testimony upon the question of relative safety. Dangerous symptoms were seen but once, and then the patient had albuminuria, although the fact was not ascertained until afterwards.]

[[1] Dr. Henry J. Bigelow, of Boston, answer to circular.]

[[2] Amer. Journ. Med. Sci., April, 1876; Nouveau Dict. de Med. et de Chir. Pratiques, t. xxiv., art. opium, 1877. Verriet-Litardière, some comparative observations published of the same series of operations, and of the same patients anæsthetized without and with a preceding injection of morphia, which give very strong testimony in favor of this plan.[1] The value of this plan may be said to be now generally recognized, particularly for protracted and severe operations. It should never be omitted in cases where great dread of the operation exists, producing an emotional state, which experience has shown to have played no insignificant part in the history of chloroform accidents. Tranquillized and soothed by the narcotic, such patients pass quietly into the anæsthetic state, and certainly escape risk otherwise encountered.

From an experience of twenty-five cases Kappeler gives an opinion decidedly unfavorable to the combined use of ether and morphia. The writer has constantly used the alcohol-chloroform-ether mixture, which is one-half ether, and has never omitted a preceding injection of morphia and atropia for severe and prolonged operations, and among them have been several ovariotomies. No bad effects have been witnessed from this combination, but the experience has not been very large. It may very certainly be stated that the stage of excitement is increased when the time between the hypodermic injection and the administration does not amount to twenty minutes.

Whenever a hypodermic injection of morphia precedes an anæsthetic, there is no question that atropia should be added. Its power as a cardiac respiratory stimulant has been long recognized[2] and distinctly taught,[3] and its value as a means of lessening the danger of respiratory and cardiac syncope under chloroform duly appreciated.[4] As a preventive of accident atropia is, without doubt, far more reliable than as a means of rescue when it has occurred.]

Nitrous oxide, which we had looked upon as of mere historical interest, as a kind of pioneer in anæsthesia, has also been revived of late years and turned to practical account, chiefly through the exertions of Dr. Evans, an American dentist residing in Paris. It is a remarkable fact that, when inhaled unmixed with atmospheric air, it fails to produce the excitement to which it owes the name of "laughing gas;" but merely throws the patient very rapidly into a condition of complete coma, attended with great lividity of the face, and staring dilatation of the pupils, presenting a very alarming appearance when seen for the first time, but, as experience shows, free from danger, subsiding as rapidly as it supervened, and leaving in the great majority of cases no trace of sickness or other unpleasant effects. The agent has recently been rendered much more portable by keeping it stored in the liquid form in a strong cast-iron bottle, from which, by turning a stopcock, the gas is supplied to an India-rubber bag, large enough to contain about an average dose for producing insensibility. When this is exhausted the balloon can be refilled in the same way as often as may be desired, and thus it is possible by a series of intermitted administrations to keep a patient under the influence of the gas for a protracted period. It is questionable, however, whether nitrous oxide, if employed for producing long continued insensibility, would prove as safe as chloroform, and it is pretty generally admitted that its legitimate place is for operations of very short duration. But for avoiding the brief but acute agony of tooth-extraction, it appears to be an unquestionable boon to humanity.

[Farther experience has not changed the relative position or very much enlarged the sphere of action of nitrous oxide. That it is the safest of all anæsthetics, has been established beyond question. In one institution, where each administration is subject of record, this gas has been given over one hundred thousand times, and not only without a death, but without causing in a single instance symptoms sufficiently serious to necessitate transporting the patient home in a carriage.[1] In the city of Philadelphia alone, it has been given over one hundred and thirty-three thousand times without a death and without any injurious results.[2] Death cannot be justly attributed to it in more than four cases since its introduction.

The feasibility of using nitrous oxide for prolonged and severe operations has been demonstrated by many surgeons, and cases have been recorded by Carnochan, Morton, Blanchet, Skene, and

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De l'anæsthésie mixte, ou de l'emploi combiné de la Morphine et du Chloroforme, Thése de Paris, 1878; Trans. Ohio State Med. Soc., 1879.]

[[1] Récherches sur l'anæsthésie chirurgicale obtenue par l'action combinée de la morphine et du Chloroforme, Par H. De Brinon, Paris, 1878; Kappeler, pp. 202–9.]

[[2] Harley, The Old Vegetable Neurotics, 1869.]

[[3] Fothergill, The Practitioner's Handbook, 2d ed., Phila., 1880.]

[[4] Bartholow, Prize Essay, Amer. Med. Assoc., 1869.]

[[1] Colton Dental Association, New York; Traité d'Anæsthésie Chirurgicale, par Dr. J. B. Rottenstein, Paris, 1880.]

[[2] Anæsthetic Manual, Dr. Laurence Turnbull, Phila., 1879.]

Sims. The latter continued the inhalation of the gas during a complicated ovariotomy lasting over an hour and a half.[1] A sufficient number of prolonged operations has not yet been performed with this anæsthetic, however, to prove that it is as safe for them as for those of brief duration. Moreover, the cost of the apparatus for liquefying the gas, the only form in which it can be of service in general surgical practice, is such as to militate against its use; while for some operations "it fails to produce a sufficient degree of muscular relaxation."[2]

Recently, Mr. Clover, of London, has produced anæsthesia by administering first nitrous oxide, and continuing the process with ether, thus escaping much of the unpleasant excitement of the latter. In this country this plan has been followed for some time by Dr. J. C. Hutchison, of Brooklyn, N. Y., "for all operations of over fifteen minutes' duration."

Kappeler states, upon the authority of Prof. Lücke, of Strasbourg, that in most of the German clinics sulphuric ether is now no longer used for local anæsthesia. "Robbins's anæsthetic ether," which, in fact, is bichloride of methylene, has been substituted for it, and is much more rapid and effective in action than ether.

An escape from the dangers of chloroform and the practical inconveniences of ether has recently been sought by the employment of new articles for anæsthetic purposes. Bromide of ethyl ($C_2H_5Br.$), sued as an anæsthetic by Mr. Nunneley, of Leeds, England, previous to 1865, has again been brought forward and warmly advocated by Drs. Turnbull and R. J. Levis, of Philadelphia. That it is pleasanter to inhale than chloroform, exceedingly rapid in producing complete unconsciousness, and very evanescent in action, can be stated from personal experience. Unfortunately, clinical experience has not brought a realization of the promise attending its introduction. Two deaths occurred in a very limited number of administrations, and whatever extenuating circumstances may be urged, confidence of the profession in its safety was destroyed, and it has been placed with amylene, among the anæsthetics which have been tried and found wanting, while the favor with which it was received, and the eagerness and frequency with which it was tried, strongly attest the existing dissatisfaction with anæsthetics at present in use.

Another substance stands now before the profession, with testimony of very high scientific character in its favor, and the endorsement of a considerable amount of equally high clinical experience. This substance is the dichloride of ethidene ($C_2H_4Cl_2$), in the language of the Anæsthetic Committee, "an isomeride of ethene dichloride produced from aldehyde." It is a liquid very much resembling chloroform in taste, smell, and appearance, and differs from its isomeride, ethene dichloride, known as "Dutch liquid," by a difference of boiling-point, and by the specific gravity, 1.182, while the latter is 1.28,[1] and by "not being decomposed by an alcoholic solution of potassa."[2] Discovered by Regnault in 1839, it was placed among the anæsthetics proper by Snow, having been first used by him, and is the subject of the last chapter of his classic work, undet the name of "monochloruretted chloride of ethyle." He administered it to sixteen patients for various operations, was well pleased with its effects, and expressed the opinion from its chemical composition, that it pretty certainly would not be liable to cause the sudden deaths which have occasionally been produced by the administration of chloroform." "Since then it has been warmly recommended by Liebreich, who placed its reliability beyond question by experiments on animals, and it has been frequently administered by Langenbeck, who emphasizes the rapidity of its action, the steadiness of its narcosis, the persistence of the anæsthesia it produces, and the lack of symptoms of irritation of the respiratory organs. Steffin, speaking from an experience of seventy-one administrations, says that it should be preferred to chloroform from the promptness of its action, its lack of modification of cardiac or respiratory actions, and the absence of unpleasant symptoms after its inhalation."[3]

During the preceding year our knowledge of the physiological and anæsthetic actions of this substance has been largely increased, chiefly as the result of the labors of the Anæsthetic Committee of the British Medical Association, already frequently mentioned. One direct object of investigation and inquiry of that committee was to discover some anæsthetic free from the dangers of chloroform and the unpleasantness of ether. The dichloride of ethidene is the only one thus far, among many failures, which seems to justify confidence. In presenting the conclusions of the committee, it is only just to again state that the experiments were conducted with the most accurate and improved apparatus, with every pre-

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[[1] Traité d'Anæs. Chir., by Rottenstein, p. 193.]

[[2] J. Marion Sims, in Traité d'Anæs. Chir., p. 193.]

[[1] Kappeler.]

[[2] Snow.]

[[3] Kappeler, p. 187.]

caution to avoid error, and every effort to attain scientific accuracy. The anæsthetics experimented with "were given intentionally in large doses, because if any substitute for chloroform is to be found, it must be one which may safely be given in exceptionally full doses."

The following are the statements of the committee:—

"Both chloroform and ethidene, administered to animals, have a decided effect in reducing the blood-pressure; while ether has no appreciable effect of this kind.

"Chloroform reduces the pressure much more rapidly, and to a greater extent than ethidene.

"Ethidene reduces the blood-pressure by regular gradations, and not, so far as observed, in the sudden and unexpected manner so often shown by chloroform.

"Under the use of ethidene, there was on no single occasion an absolute cessation, either of the heart's action or of respiration, although they were sometimes very much reduced. It can therefore be said that, though not free from danger on the side of the heart and respiration, this agent is in a very high degree safer than chloroform.

"As regards comparative danger, the three anæsthetics may be arranged in the following order: Chloroform, ethidene, ether; and the ease with which the vital functions can be restored may be conversely stated, thus: the circulation is more easily re-established when its cessation is due to ether than to ethidene; and when the result of ethidene than when chloroform has been used."

The investigation of this new anæsthetic has not been limited to its physiological effects. The committee conducted a series of practical observations at the Western Infirmary, Glasgow. It was administered to fifty cases of operation, including two ovariotomies, and the symptoms and results carefully observed and noted, and compared with those of an equal number of chloroform administrations. From these observations it appears that the average time required to anæsthetize a patient with ethidene is somewhat less (1.1 minute) than with chloroform.

The average amount of ethidene used per case (the administration being from a towel) was 40.3 c.c., while that of chloroform was 31.8.

The average time of recovery from the effect was, for chloroform, 4.8 minutes; for ethidene, 4.4.

As to consecutive and subsequent nausea and vomiting, it was about the same with both agents, the duration being greater with chloroform. These symptoms bear "no relation to the length of time the patient has been under, or reference to the quantity of the anæsthetic administered in a given time."

"With both agents, the pulse-respiration ratio is considerably altered in a certain number of cases, the pulse falling as the respirations increase in frequency. With chloroform this change is not only much more marked, but its occurrence is also more frequent than with ethidene; the proportion in our experience being nine of the former to two of the latter. There is also a greater tendency, in cases of chloroform, to retardation of the heart's movements and to dicrotism."

The results of a much longer clinical experience with ethidene have been published by Mr. Clover,[1] than whom no one is more competent to investigate, or to express an opinion upon, the relative value of a new anæsthetic. He has administered it for 1877 operations, of which 287 were major. Two patients, one of them a delicate child nine years old, were kept under the influence of the agent an hour and a half. The patients recovered rapidly, and vomiting followed in about one-third of the cases of major surgery, and in about one-twentieth of the minor. In regard to the symptoms attending induction of anæsthesia, we have no information from Mr. Clover, as his plan has been to bring the patient under the influence of nitrous oxide, and then gradually substitute the ethidene.

Notwithstanding the very favorable results of experiment with animals, Mr. Clover's experience has shown that in the human subject ethidene sometimes depresses the heart's action, and even to an alarming extent; on three occasions he was obliged to lower the patient's head and resort to artificial respiration. Unfortunately, too, one fatal case occurred to him during the administration. The patient was an adult male, and the post-mortem examination showed a heart loaded with fat, the muscular substance of which had undergone extensive fatty degeneration. While Mr. Clover does not believe the anæsthetic to have been more than indirectly fatal, he admits that its reputation will suffer.

Kappeler mentions a fatal case as having occurred in Berlin, but without giving any particulars.

What position ethidene will take among anæsthetics, the future must determine. Certainly, no agent thus far used has ever been brought before the profession in so favorable a manner, or with such abundant and reliable testimony in its favor.[2]]

[[1] British Med. Journ., May 29, 1880.]

[[2] To publications in regard to ethidene, the following references are given from Kappeler: Liebreich, Berl. Klin. Wochenschrift, The benumbing influence of cold was brought into requisition several years ago by Dr. James Arnott for producing local anæsthesia, by means of a freezing mixture of pounded ice and common salt.[1] The same object has since been more efficiently attained by Dr. B. W. Richardson, by ingeniously availing himself of the reduction of temperature occasioned by evaporation. Anhydrous sulphuric ether intimately mingled with air in the form of spray is projected upon the part by means of a suitable apparatus easily worked by the hand. In a few seconds the skin upon which the spray plays suddenly assumes a snow-white color, implying that its surface is completely frozen. It is well to continue the application for a little while after this change has occurred, in order to ensure the penetration of the effect to a sufficient depth. The frozen parts may then be incised or operated on in any way that may be desirable, without the slightest pain to the patient, and the tissues when thawed are generally as well disposed for healing as usual.

This method is necessarily of limited application. It is only adapted for superficial operations, and even for many of these the rigidity of the tissues occasioned by congelation is inconsistent with efficiency of performance; as in removing epithelial cancers, where the sense of touch is the principal guide for the surgeon; or again in taking away thin-walled atheromatous cysts, where looseness of the surrounding cellular tissue is essential to satisfactory dissection. Nevertheless there are many cases, such as the incising of a boil or the removal of the nail of the great toe, in which this means of producing local anæsthesia proves perfectly satisfactory. In operating on the extremities I have found great advantage from restraining the circulation with a tourniquet, so as to prevent the oozing of hot blood, which would otherwise interfere with maintaining the frozen condition or extending it to deeper parts.

[In the case of children, Prof. Bouchut advocates the use of chloral as an anæsthetic for operations—dose about 45 grains—the effect begins in about 15 minutes, and is complete in an hour. The child may move a little, but does not wake, if incisions are made, teeth extracted, or caustics applied. The sleep continues for four or five hours afterwards, when the child wakes unaware of what has passed.[1]]

[NOTE BY THE EDITOR-IN-CHIEF.—At a variable period after the beginning of inhalation of chloroform or ether, the patient passes through a stage of "primary anæsthesia," marked by total muscular relaxation. During this period, the duration of which seems also to be variable, abscesses may be opened, luxations reduced, or any short operation performed, without any sensation of pain on the part of the patient; and on the withdrawal of the anæsthetic, the effects pass off at once without headache, nausea, or other inconvenience.

The best way of detecting this period is to let the patient hold one hand up, and to urge him to do so. As soon as the hand drops the time has arrived, and should be instantly taken advantage of.

Extensive experience has convinced me as well as many others of the value of this simple fact in practice.[2]—P.]

AMPUTATION.

BY JOSEPH LISTER, F.R.S.

Revised by CHARLES T. HUNTER, M.D., and JOHN H. PACKARD, M.D.

AMPUTATION is often regarded as an opprobrium of the healing art. But while the human frame remains liable to derangement from accident or disease, the removal of hopelessly disordered parts, in the way most conducive to the safety and future comfort of the sufferer, must ever claim the best attention of the surgeon. Indeed, the progress of medical science, while furnishing the means of

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No. 31, 1870; Langenbeck, Ibid., No. 33, 1870; Steffin, Ibid., No. 6, 1872; Sauer, Pharm., Centralhalle 14, s. 140.]

[1] See The Lancet, October 30, 1858.

[[1] Lancet, Dec. 11, 1875, p. 665.]

[[2] See Philadelphia Med. Times, Feb. 15, 1872; Am. Journ. of Med. Sciences, July, 1877, and April, 1878.—P.]

curing some affections once regarded as hopeless, and thus in one sense restricting the field for the application of amputation, has in another point of view extended that field, by improving the mode of operative procedure, and divesting it of much of its terrors and danger; so that whereas in former times the removal of a limb was only resorted to in cases of the most serious nature, it is now often practised when the offending member is merely a source of inconvenience.

It is instructive to trace the history of the improvement of this department of surgery.

Hippocrates (B. C. 430) recommended only a very rude kind of amputation, consisting of cutting through mortified limbs at some joint, "care being taken not to wound any living part."[1]

On the other hand, Celsus, who seems to have lived at the commencement of the Christian era, advised that the removal of gangrenous limbs should be effected between the dead and living parts, and so as rather to take away some of the healthy textures than leave any that were diseased; and as he interdicted amputation through an articulation, his operations must often have been performed entirely through sound tissues. He directed that the soft parts should be divided with a knife down to the bone, and then dissected up from it for some distance, so as to allow the saw to be applied at a higher level. The rough surface of the sawn bone was then to be smoothed off, and the soft parts, which, as he tells us, will be lax if this plan be pursued, were to be brought down so as to cover the end of the bone as much as possible. This method seems calculated to afford good results; particularly as it appears probable from his writings that Celsus employed the ligature for arresting hemorrhage after amputation,[2] and dressed the stump in a manner favorable to the occurrence of primary union.

Archigenes, who practised in Rome shortly after the time of Celsus, paid special attention to the control of hemorrhage during the performance of the operation; and appears to have been the first to employ for this purpose a tight band or fillet encircling the limb above the site of amputation. But while in this he did good service, he applied the red-hot iron to the surface of the stump, and also neglected the dissection of the soft parts from the bone, advised by Celsus, though compensating to a certain extent for this omission by retracting the integuments before dividing them.[1]

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[1] Hippocrates de Articulis, p. 639 of the Sydenham Society's translation.

[2] On this interesting point in surgical history I am disposed to agree with the author of the article "Amputation" in Rees's Cyclopædia, in opposition to the prevalent opinion that Celsus employed the ligature only in ordinary wounds, and used the actual cautery in amputations. The directions of Celsus regarding amputation are contained in his chapter on the treatment of gangrene, in which the only mention of hemorrhage is the statement that patients often die of it during the performance of the operation (*in ipso opere*), referring doubtless to profuse bleeding resulting from ignorance of the circulation of the blood, and of any means of controlling it in the limb. Certainly this expression is no proof that the cautery was used rather than the ligature; for the former is the more speedy method of the two. Neither is the absence of allusion to the ligature in this passage any evidence against its employment after amputation; for the argument would apply equally to the cautery, and no one doubts that one of these two means was used. Celsus, who is remarkable for his extremely concise style, leaves us to refer to his previous chapter on wounds, in which the subject of hemorrhage is very ably discussed. In slight cases, pressure with dry lint, and a sponge wrung out of cold water, is recommended, or if this does not answer, lint steeped in vinegar is to be used; but any portion of dressing retained in the wound is said to do mischief by causing inflammation; and on the same principle caustics and other powerful styptics, though very efficient in arresting the bleeding, are prohibited because they produce a crust, which acts like a foreign body. In more severe cases the vessels are to be tied; and finally, "when the circumstances do not even admit of this," the red-hot iron may be used as a last resort.

The only thing that seems to me to give any color for doubt upon this subject, is the manner in which the ligature is described, "venæ quæ sanguinem fundunt apprehendendæ, circaque id quod ictum est duobus locis deligandæ intercidendæque sunt;" language which seems rather to apply to a partially divided artery than to one completely severed; but as the context shows that the ligature, as used by Celsus, was applicable in the majority of cases, and to more vessels than one in the same wound, it can hardly be conceived possible that the practice was restricted to the very rare case of partial division.

Again, there can be little doubt that in drawing down the soft parts over the bone after amputation, Celsus aimed at primary union, the great advantages of which are strongly insisted on in the same admirable chapter on wounds; but it is certain that he knew that the use of the cautery would have destroyed any chance of union by first intention.

One argument that has been urged on the other side is, that if he had employed the ligature in amputation, it would hardly have been neglected by his successors; but the slowness of the surgeons of the sixteenth and seventeenth centuries to adopt it, in spite of the strenuous advocacy of Paré, with all the advantages of a printed literature, show how little weight is to be attached to this objection. The utter neglect, during the middle ages, of the Celsian method of amputation, and of his simple mode of treating wounds, may also be mentioned as analogous cases.

Galen, who was in truth more of a physician than a surgeon, declined still more from the Celsian precepts, and, reverting to the practice of Hippocrates, advised amputating through the dead tissues, and applying the cautery to the residue of the mortified part;[2] and for several centuries after his time either this method or others equally rude and often much more barbarous continued to be employed.

During the middle ages, the ligature, though used for ordinary wounds, was never thought of in amputation; and whatever may have been the practice of Celsus in this respect, there is no doubt that the great French surgeon Ambroise Paré, when he so applied it, in the middle of the sixteenth century, had all the merit of originality. But though he urged its superiority over the cautery with able argument, supported by his extensive experience in both military and civil practice, yet his teaching failed for a long time to influence surgeons generally, either in his own country, or in other parts of Europe.

The principal reason for this appears to have been that the fillet, which was the means still in use for controlling the bleeding during the operation, did not answer its purpose effectually even in the ablest hands; so that the dread of hemorrhage led most surgeons to prefer the cautery as a more expeditious method than the ligature. We even find Fabricius of Aquapendente repeating, in 1618, Galen's timid doctrine of the danger of amputating through living parts at all;[3] and in 1633 the celebrated Fabricius Hildanus, though describing the ligature, states that the time which it occupies, and the consequent loss of blood, make it suitable only for the robust and plethoric, and declares that he "cannot sufficiently extol the excellence" of the *cauterium cultellare*, or red-hot knife, by which the orifices of the vessels were sealed while they were divided.[4]

In consequence of this same fear of bleeding, the great object at this period seems to have been to accomplish the work of severance of the limb as speedily as possible, and this was often done without any attempt whatever to provide a covering for the bone. Scultetus, in 1655, depicted the performance of amputation of the hand by chisel and mallet; and Purmannus, in his Chirurgia Curiosa, written as late as 1696, mentions having seen legs removed by two different surgeons by modifications of a barbarous instrument of the middle ages, a sort of guillotine, "which, by its great weight and sharpness, cuts at once the skin, flesh, and bones asunder;" but he states that it splintered the bone, and *therefore*, "all things considered, the ancient way of cutting through the flesh with a knife, and through the bone with a saw, is more practicable, safe, and certain."[1]

As an example of the ordinary practice of the seventeenth century may be mentioned that of Richard Wiseman, Sergeant-Surgeon to King Charles II. A fillet having been tightly applied, for the threefold purpose of checking hemorrhage, rendering the limb less sensitive by pressure on the nerves, and steadying the soft parts, which were retracted by an assistant, he carried a crooked knife by a single circular sweep down to the bone, which was divided with the saw at the same level, and the bleeding was arrested by the cautery, or some kind of styptic.[2]

Thus the mode of amputation employed by the father of British surgery not two centuries ago, was precisely that used fifteen hundred years before by the Roman Archigenes. And very unsatisfactory were the results which it commonly afforded. The soft parts were insufficient, even in the first instance, to cover the end of the bone, which was accordingly cauterized, with the object of accelerating its inevitable exfoliation, and in the further progress of the case it tended to become more and more exposed by the contraction of the muscles; and even if the patient survived the protracted suppuration that ensued, he suffered more or less from the inconveniences of what has been called the sugar-loaf stump [see fig. 779], being in the shape of a cone, the apex of which was formed by the prominent bone, covered either by a sore which refused to heal, or by a thin pellicle of cicatrix, very liable to abrasion.

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[1] Sprengel's History of Medicine, French translation, vol. ii., p. 81, and vol. vii., p. 312.

[2] Galeni ad Glauconem, lib. ii., cap. xi.

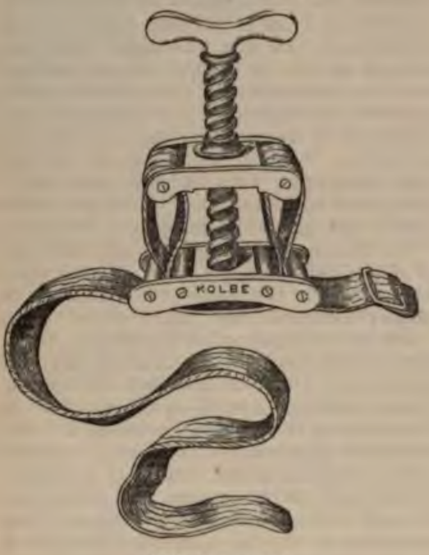
[3] Hieronymi Fabricii ab Aquapendente Opera Chirurgica, pars i., cap. xcvi.

[4] "Porro excellentiam hujus cauterii non satis extollere possum." Gul. Fabricii Hildani Opera ommia, lib. de Gangrænâ et Sphacelo.

[1] Purmannus's Chirurgia Curiosa, English transl., book iii., chap. xii.

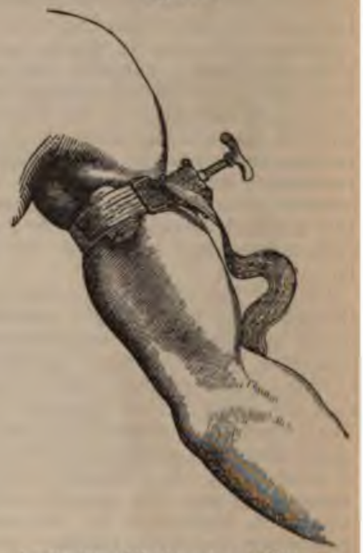
[2] The ligature, though known to Wiseman, seems not to have been adopted by him. After describing different modes of applying it, in a way that shows pretty clearly that he had not practised them, he writes, "But the late discovery of the royal styptic hath rendered them of less use. But in the heat of fight it will be necessary to have your actual cautery always ready, for that will secure the bleeding arteries in a moment, and fortify the part against the future putrefaction."—Chirurgical Treatises, book vi.

[Fig. 772.



Petit's tourniquet.

Fig. 773.



Application of the tourniquet (Miller).]

A great step towards a better order of things was made in 1674 by the French surgeon Morel, in the invention of the tourniquet,[1] which, though at first but a rude contrivance, being a stick passed beneath the fillet and turned round so as to twist it up to the requisite degree of tightness, furnished the basis for the greatly improved instrument devised in the early part of the following century by his distinguished countryman, J. L. Petit. This consisted essentially of two metallic plates, which could be separated from one another by means of a screw, so as to tighten a strap which was connected with them and also encircled the limb; and it is upon this principle that the ordinary screw tourniquet is still constructed. From this time forward, except in amputations performed near the trunk, hemorrhage during the operation ceased to be an object of dread, and surgeons were at liberty to consider other questions besides mere rapidity of execution.

The improver of the tourniquet, and our own great countryman, Cheselden, seem to have conceived, independently of each other, the idea of performing amputation by "double incision;" in which the skin and fat were first cut through by a circular sweep of the knife and retracted for about an inch, when the muscles and bone were divided as high as they were exposed.[1]

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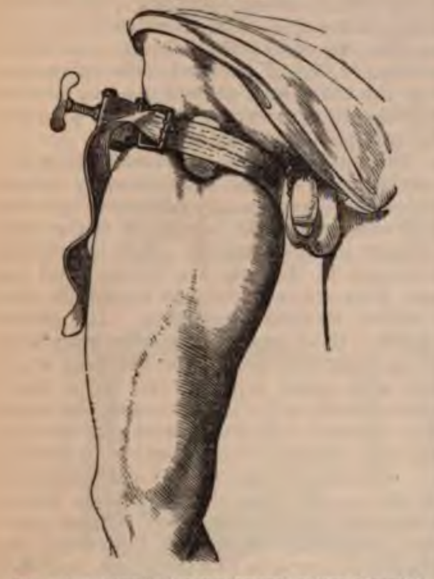
[1] English surgeons might dispute with the French the honor of the invention of the tourniquet. In a work written in 1678, published in 1679, entitled Currus Triumphalis e Terebintho, Mr. James Young, of Plymouth, gives an account of a similar contrivance, apparently produced independently by himself. He describes it as "a wadd of hard linen cloth, or the like, inside the thigh, a little below the inguen; then, passing a towel round the member, knit the ends of it together, and with a battoon or bedstaff, or the like, twist it till it compress the wadd or boulster so very straight on the crural vessels that (the circulation being stopped in them) their bleeding, when divided by the incision, shall be scarce large enough to let him see where to apply his restrictives" (p. 30). Further on in the book he states that the same principle is applicable with advantage in amputations of the upper limb. But as he does not inform us how long he had used this expedient before he wrote the account of it, the credit of priority must of course be accorded to Morel.

[1] It is difficult to determine to whom the priority belongs in this matter. Petit in his posthumous work states: "Je suis le premier qui ait coupé les chairs en deux temps;" and also "J'ai imaginé de couper les chairs en deux temps;" and Dieffenbach, in his Operative Surgery, gives 1718 as the date of the introduction of the double incision by Petit.

But this, though a great improvement, had only the effect of diminishing the cicatrix without covering the bone ;[1] and Louis, another eminent Parisian surgeon, believed that in the thigh the objects sought might be better attained by dividing all the soft parts at once, and sawing the bone at a higher level. In order to allow the muscles to contract freely when divided, he avoided the use of the tourniquet, and was the first to employ in its place digital compression of the femoral artery at the groin. He pointed out the important circumstance that the muscles on the posterior aspect of the thigh being divided far from their origin at the pelvis, contract to a much greater extent than those at the anterior part of the limb, which are connected with the bone where they are cut; and he showed that, the soft parts having been severed to the bone by a circular incision and drawn up with a linen retractor, the saw might be readily applied two and a half inches higher up, after the knife had been carried through the attachments of the anterior muscles.[1] This method was amputation by double incision on a different principle; and though, in truth, a revival of the practice of Celsus, was not less valuable than the plan of Cheselden and Petit, and seems to have afforded results superior to theirs.[2]

[Fig. 774.



Tourniquet applied to the femoral artery (Gross).]

Louis, however, was content if the stump when healed was free from conical projection,[3] and did not aim at forming a complete covering for the bone. This was effectually done about a quarter of a century later by Alanson, of Liverpool, by dissecting up the integuments for some distance, and then dividing the muscles obliquely, so that they formed a hollow cone, in the apex of which the bone was sawn "about three or four fingers' breadth higher than was usually done." The effect of this was to "fully cover the whole surface of the wound with the most perfect ease;"[4] but in the hands of other surgeons the oblique division of the muscles proved to be a matter of considerable difficulty, and the object was accomplished as efficiently and more simply by Mr. Benjamin Bell, of Edinburgh,[5] and Mr. Hey, of Leeds, by a combination of the methods of Cheselden and Louis; or, as Mr. Hey expressed it, "with a triple incision,"[6] in which the skin and fat were first divided circularly and dissected up for some distance, then the muscles were cut at a higher level, and these were retracted so as to permit the bone to be exposed and sawn considerably higher. Mr. Hey added the advice to cut the posterior muscles somewhat longer than the anterior, to compensate for their greater contraction; and thus, towards the end of the last century, "the circular operation," as it is termed, may be said to have been brought to perfection.

On the other hand, Cheselden as distinctly claims the original idea, in the following passage in his notes to Gataker's translation of Le Dran's Surgery: "The thing that led me to do this was what has too often happened—the necessity of cutting off the end of the stump the second time. This operation I proposed to my master when I was his apprentice; but he treated it with neglect, though he lived afterwards to practise it when he had seen me perform it in the same hospital." This proposal must have been made before 1711, when, at the age of twenty-two, he began to lecture on anatomy.

[1] This is well illustrated by the drawing of a stump given by Cheselden in Le Dran's Surgery, for the purpose of showing the good effects of the double incision.

[1] Mémoires de l'Académie de Chirurgie, vol. ii., p. 286.

[2] Mémoires de l'Académie de Chirurgie, vol. iv., p. 60.

[3] "L'amputation la plus parfaite est, sans contredit, celle dans laquelle les chairs qui forment l'extrémité du moignon conservent assez de longueur pour se maintenir au niveau du bout de l'os." Op. cit., vol. iv., p. 41.

[4] Alanson's Practical Observations on Amputation, 2d edit., p. 16.

[5] Benjamin Bell's System of Surgery, 7th edit., vol. vii., p. 260.

[6] Hey's Practical Observations, 3d edit., p. 527.

Meanwhile a different principle had been long before suggested and acted upon. So early as 1678, Mr. James Young, of Plymouth, described "a way of amputating large members, so as to be able to cure them *per symphysin* in three weeks, and without fouling and scaling the bone." The directions given for this method, the "first hints" of which, he says, he had "from a very ingenious brother of ours, Mr. C. Lowdham, of Exeter," are as follows: "You are with the catling, or some long incision-knife, to raise (suppose it the leg) a flap of the membranous flesh covering the muscles of the calf, beginning below the place where you intend to make excision, and raising it thitherward of length enough to cover the stump; having so done, turn it back under the hand of him that gripes; and as soon as you have severed the member, bring this flap of cutaneous flesh over the stump, and fasten it to the edges thereof by four or five strong stitches."[1] Eighteen years later Verduin, a surgeon of Amsterdam, ignorant apparently of what Lowdham had done, provided like him a covering for the end of the stump from the calf; but instead of cutting from below upward, and only raising the integuments, he thrust a knife behind the bones at the part where he intended to divide them, and cutting downward formed a muscular flap, which he afterwards supported by an apparatus devised for the purpose of pressing the cut surfaces together so as to check bleeding without the use of either cautery or ligature.[2] This machine being complicated and unsatisfactory, was rejected in 1750 by M. Garangeot,[3] who, substituting the ligature for it, but retaining in other respects the method of Verduin, brought amputation of the leg to the form in which it is still often practised at the present day.

The same principle was applied to the thigh, in 1739, by Ravaton, of Landau; but instead of one long flap he made two short ones. Having divided all the soft parts circularly, he thrust a knife down to the bone on the anterior aspect of the limb, a hand's-breadth higher up, and cut down to the circular wound; and, having made a similar longitudinal incision behind, dissected up the square lateral flaps thus formed, and sawed the bone where it was exposed at their angle of union, and brought them together after tying the vessels.[1]

Vermale, surgeon to the Elector Palatine, soon afterwards formed the flaps more easily, and of a shape better adapted for union, by introducing a knife at the front of the limb and pushing it round the bone at one side, so as to make it emerge at the opposite point behind, and then cutting a flap of rounded form by carrying the knife in a curved manner downwards and outwards, the same process being repeated on the other side.[2]

The flap operation, performed either by cutting from without inwards or by transfixion, was occasionally employed by various surgeons in the latter half of the last century; but found its most strenuous advocate in the late Mr. Liston, and at one time seemed likely to supersede the circular method altogether. Its great merit in those days of painful surgery was its facility and speed; for the flaps were cut with great rapidity, and when they were drawn up by the assistant, the bone was exposed with the utmost readiness at the part where it was desirable to divide it; whereas, in the circular operation, to dissect up the ring of integuments was a somewhat troublesome and tedious process, especially in a limb increasing in thickness upwards like the thigh, and the use of a retractor was often necessary, in order that the saw might be applied at a sufficiently high level.

As regards the immediate results of the two methods, the principal difference between them was, that the flaps, when formed by transfixion, contained a large amount of muscle, while the circular mode furnished a covering chiefly from the integument. In this respect the flap operation was at first supposed to have a great advantage, as providing a muscular cushion for the end of the stump. But this opinion was shaken by further experience. The muscular part of the covering, no longer discharging its normal physiological function, degenerates and dwindles, while the integument tends to become thicker and firmer, so that the ultimate results of the flap and circular operations present no material difference. On the other hand, at the time of the performance of the operation, the method by transfixion has the great disadvantage that the muscular element in the flap is almost always redundant, and has to be tucked back to permit the edges of the skin to be stitched together, the natural result being tension and confinement of discharges and consequent inflammatory disturbance. In the very case in which the flap operation was first employed, viz., in the upper part of the leg, the muscular mass proved very inconvenient from its redundancy, when the calf was largely developed; and even under more favorable circumstances the heavy and contractile flap was apt to shift from its position or to drag down the skin of the front of the leg, so as to stretch it on the cut end of the tibia, and induce ulceration. Hence Mr. Liston himself, so early as 1839, preferred in muscular subjects a short posterior flap, and an anterior one of the same length, composed of integument only;[1] and in the latter period of his practice he changed this for the following modification of the circular operation, which was also suggested independently by Mr. Syme, and was used by him for many years in all cases of amputation in this situation. The skin and fat are divided by two crescentic incisions with the convexity downwards, so as to form short antero-posterior flaps of the integument, which is then dissected up considerably higher than their angle of union, after which the operation is completed as in the ordinary circular method.[1] [Fig. 775 shows this mode of operating; the muscles have not yet been divided.—P.] This plan gives essentially the same result as the circular mode, while the raising of the integument is facilitated, and its edges can be accurately adapted to each other without any of the puckering that occurred at the angles of the wound after the old operation; and experience shows that when the soft parts have been divided in this way they are quite as favorably disposed for primary union as when cut more smoothly in the form of flaps.

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[1] James Young's Currus Triumphalis e Terebintho, p. 108. A copy of this interesting book exists in the library of the Royal Medical and Chirurgical Society of London.

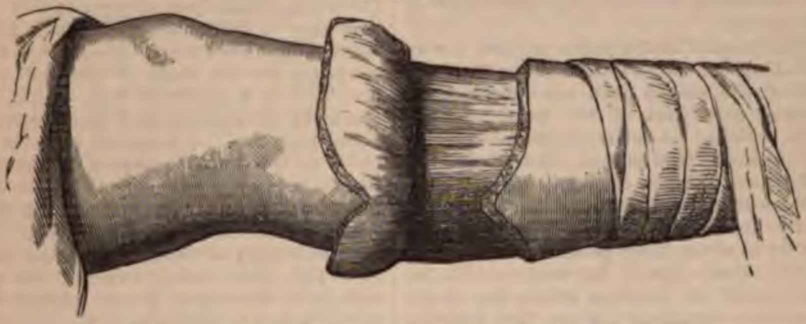
[2] Memoires de l'Académie de Chirurgie, vol. ii., p. 244.

[3] Ibid., p. 261.

[1] Ravaton's Traité d'Armes à feu, p. 405; also, Mémoires de l'Académie, vol. ii., p. 251.

[2] Le Dran's Surgery, Gataker's translation, p. 431.

[Fig. 775.



Modified circular amputation in the upper third of the leg (Erichsen).]

[Prof. Agnew[2] has suggested a modification of the musculo-tegumentary flap operation, which obviates very perfectly the redundancy of the muscular elements of the flaps. This consists in first making the elliptical incisions through the integuments, then, after dissecting up the integuments a short distance, one-quarter or one-third the length of the proposed flaps, entering "the knife at the angle of the wound. between the muscles and the bones, and cutting downward and outwards, first on one side and then on the other, terminating the incisions at the line where the tegumentary flaps are attached." When the flaps are thus fashioned, the skin and the muscles, in consequence of the greater retraction of the former, will either be of equal length, or the skin will project a little beyond the muscles.

Dr. McGill, U. S. A., advises that the periosteum be reflected with the flaps, to cover the sawn extremity of the bone in amputation. This plan has been repeatedly adopted by Dr. McGill and other surgeons with most excellent effect. When the periosteum is laid over the end of the divided bone it covers the exposed medullary tissue and prevents absorption of the discharges of the structure that accumulate between the flaps, and, likewise, renders necrosis of the stump less liable to occur.—H.]

In the lower part of the thigh, also, the presence of the contractile element in the flaps was found to be injurious by increasing the disposition to protrusion of the bone, from the action of the powerful ham-string muscles, cut so far from their origin at the pelvis. Mr. Syme accordingly adapted his modification of the circular method to that situation;[2] and I can testify to the sufficiency of the covering which it afforded.

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[1] Liston's Elements of Surgery, 2d edit., p. 786.

[[2] Agnew's Surgery, vol. ii., p. 305.—H.]

[1] Syme's Principles of Surgery, 5th edit., p. 168.

[2] Ibid., p. 170.

The longer time required for this operation than that by flap was rendered a matter of no moment by the discovery of anæsthesia in surgery, in the year 1846.[1] Independently of the relief from bodily and mental suffering procured by this great event, it must be regarded as an era in the history of amputation, of at least equal importance with the invention of the tourniquet; because, pain being abolished during the operation, as well as dangerous hemorrhage, surgeons are now, in the great majority of cases, deprived of all excuse for sacrificing any thing, either in plan or execution, to mere rapidity of performance, and are enabled to regard simply what will most promote the two great ultimate objects in amputation—safety to life, and usefulness of the stump.

With regard to the latter object, it was till lately an understood thing that the end of the stump was not adapted for bearing any part of the weight of the body. Being tender from the presence of the cicatrix, it was not allowed by the instrument makers to touch the artificial limb at all; the apparatus being applied partly to the sides of the stump, but chiefly to some bony prominence resting on the upper edge of the socket—the tuberosity of the ischium when the thigh is concerned, and in the leg the internal tuberosity of the tibia, the head of the fibula, and especially the lower border of the patella.

To this general rule, however, a striking exception was presented by the amputation at the ankle devised by Mr. Syme, in which the bones are divided just above the malleoli, where they present a broad surface for diffusing the pressure over the integument of the heel turned up to cover them, specially fitted by the character of its epidermic investment and subcutaneous fibro-adipose cushion for bearing the weight of the body, while the cicatrix lies well forward out of reach of pressure. The result is that the patient can stand on the end of the stump as on the natural sole; and when the deficient spring of the arch of the foot is compensated by some elastic material contained in a very simple boot, the limb proves nearly as useful as in its normal condition.

Subsequent experience has shown that similar advantages may be attained to a greater or less degree in stumps formed by amputation higher up the limb. It is easy by proper management to ensure the cicatrix falling out of reach of compression by the end of the bone; and the integument, though tender in the first instance, gradually acquires a brawny and callous character when subjected to regulated pressure, like the skin over the dorsal aspect of the cuboid bone in talipes varus, and thus becomes able to bear the whole or part of the weight of the body according to the breadth of the cut surface of the bone, and the consequent diffusion of the pressure. Indeed, stumps possessing these qualities were occasionally obtained as long ago as the time of Alanson, who, speaking of the condition of a patient on whom he had performed amputation above the ankle by posterior flap, says: "He has been several voyages to sea, and done his business with great activity. He bears the pressure of the machine totally upon the end of the stump, and has not been troubled with the least excoriation or soreness."[1] But it is easy to understand why such results were altogether exceptional so long as the covering for the ends of the bones was provided by a posterior flap, which, from the force of gravity and the preponderating power of the posterior muscles over those at the anterior aspect of the limb, must always tend to drop from its original position, and leave some part of the bone to be covered only by cicatrix. And independently of this, in the case of the leg, the tibia being covered in front merely by the skin, a scar placed anteriorly is much more likely to suffer from pressure against the bone than one situated posteriorly. The amputation at the ankle is, indeed, by posterior flap; but the full rounded cushion formed by the cup-shaped integument of the heel renders this an entirely exceptional case. It is plain, therefore, that with reference to fitness of the stump for bearing the weight of the body, preference should be given to an anterior flap, which moreover has the great advantage of allowing a dependent opening for the escape of discharge.

The recognition of the advantages of the anterior flap is due to the labors of two English surgeons, the late Mr. Teale, of Leeds, and Mr. Carden, of Worcester, working independently of each other, and proceeding by different methods. Mr. Teale, who had the priority in publication, formed a long anterior and short posterior flap in the following manner. Having ascertained by measurement the semi-circumference of the limb where the bone was to be divided, he first traced with pen and ink upon the skin four lines of that length; two longitudinal, extending downwards along the sides of the limb, and two transverse, of which one joined in front the lower ends of the longitudinal lines, while the other ran across behind from one longitudinal line to the other at the distance of a quarter of their length from their upper extremities. Two rectangular flaps of very unequal lengths being thus mapped out, he raised them, including the muscles as well as the integuments, by cutting from without inwards, and sawed the bone at their angle of union; then, after tying the vessels, he bent the long anterior flap upon itself, that it might "form a kind of pouch for the end of the bone," turning up its lower edge to meet that of the short posterior flap, to which it was carefully adjusted and united by a few points of suture, some stitches being also introduced where the edges of the skin met at the sides of the stump.[1]

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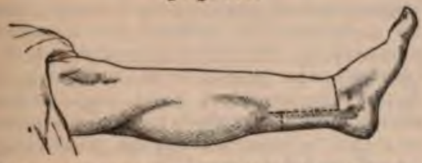
[1] See the Essay on ANÆSTHETICS in this work.

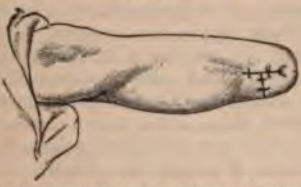
[1] Alanson On Amputation, p. 133.

[Fig. 776.



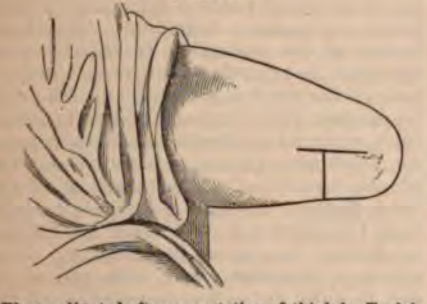
Teale's amputation in lower third of leg (Bryant).

Fig. 777.



Teale's amputation; flaps adjusted (Bryant).]

[Fig. 778.



Flaps adjusted after amputation of thigh by Teale's method.]

Experience with this method has shown that in properly selected cases it gives admirable results, the patient being often able to rest his entire weight upon the end of the stump; and even where this is not fully the case, the distribution of the pressure between the end of the stump and the bony prominences which formerly alone sustained it greatly increases the comfort and steadiness of locomotion.

Nevertheless it must be admitted that Mr. Teale's operation has serious drawbacks. Precise accuracy of execution being essential to its success, it demands a degree of time and pains which, under ordinary circumstances, would certainly not be grudged, if really necessary, but which most surgeons would be glad to be saved, and which sometimes, as in the pressure of military practice, could not well be given. Again, the cut surface is more extensive than with ordinary modes of amputation, involving a larger number of vessels to secure, and also, under some conditions of healing, a more profuse suppuration. But the greatest objection to this method with a view to its general application is the high division of the bone which would frequently be required in order to form the long anterior flap. This defect is of course most marked when the limb is of considerable thickness at the seat of amputation, and shows itself in its most exaggerated form in the thigh of a muscular subject. Thus in a particular instance, where the development was by no means extraordinary, the dimensions were such, that, supposing the anterior transverse incision made at the level of the upper border of the patella, it would have been necessary, in order to preserve Mr. Teale's proportions, to saw the bone eleven inches further up, or full five inches higher than if the modified circular operation had been performed. This would most seriously have increased the danger, which is always greater the nearer the seat of amputation is to the trunk,[1] while in case of recovery, the short stump would have been very inferior in usefulness on account of the slightness of the leverage it could have exerted in controlling the movements of an artificial limb.

The same disadvantage would often be experienced in applying the method to the leg. Near the ankle, indeed, where the limb is small and the anterior flap short in proportion, the operation is comparatively free from this objection. But if the circumstances of the case should render it necessary to amputate higher in the limb, the rapid increase of the thickness of the calf would necessitate a higher division of the bone greatly out of proportion to the extent of the injury or disease of the soft parts. In a leg of about average development the amputation at

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[1] Teale On Amputation, p. 34 et seq.

[1] This principle has been pithily expressed by Dieffenbach in the words "zollweise steigt die Gefahr." (Operative Chirurgie, vol. ii., p. 822.)

Mr. Teale's seat of election, dividing the bones just below the calf, would require the integuments to be sound to the level of the tip of the internal malleolus. But if the skin happened to be unsound to a quarter of an inch above that level, the bones would have to be divided an inch higher; and a difference of three-quarters of an inch in the skin would involve a loss of two inches of the bones; and again an affection of the integuments implicating less than two inches above the tip of the malleolus would require a division of the bones full four inches above Teale's seat of election. And in the last-named situation, where the calf is thickest, the very long flap, consisting in the greater part of its breadth of skin alone, would be very liable to suffer from sloughing.

From considerations like these some of the staunchest advocates of Mr. Teale's method are now disposed to restrict it to the lower part of the leg and just above the knee, where, by turning to account the integument over the patella, which is not used in ordinary operations, the anterior flap may be made of the requisite length without specially high division of the bone.

Mr. Carden proceeded upon a much more simple plan; forming a rounded anterior flap of integument only, without any posterior flap, and retracting the soft parts somewhat from the bone before dividing it with the saw; "thus forming a flat-faced stump with a bonnet of integument to fall over it."[1] This practice he began as early as 1846, nine years before Mr. Teale first employed his rectangular operation; and though refraining from publication, he obtained from that time forward most admirable results, both in safety to life and the amount of pressure that could be borne by the end of the stump.

It was principally at the knee, where amputation had not previously been much practised, that Mr. Carden applied his principle. The operation at this situation is thus described by him: "The operator, standing on the right side of the limb, seizes it between his left forefinger and thumb at the spots selected for the base of the flap, and enters the point of the knife close to his finger, bringing it round through skin and fat below the patella to the spot pressed by his thumb; then turning the edge downwards at a right angle with the line of the limb, he passes it through to the spot where it first entered, cutting outwards through everything behind the bone. The flap is then reflected, and the remainder of the soft parts divided straight down to the bone; the muscles are then slightly cleared upward, and the saw is applied" through the bases of the condyles. "Or the flap may be reflected first, and the knee examined, particularly if the operator be undetermined between resection and amputation. In amputating through the condyles, the patella is drawn down by flexing the knee to a right angle before dividing the soft parts in front of the bone; or if that be inconvenient, the patella may be reflected downward."[1]

This operation, when contrasted with amputation in the lower third of the thigh, presents a remarkable combination of advantages. It is less serious in its immediate effects upon the system, because a considerably smaller portion of the body is removed, and also because, the limb being divided where it consists of little else than skin, bone, and tendons, fewer bloodvessels are cut than when the knife is carried through the highly vascular muscles of the thigh; the popliteal and one or two articular branches being, as a general rule, all that require attention, so that loss of blood, whether from immediate or secondary hemorrhage, is much diminished. In the further progress of the case the chance of exfoliation, with its attendant delay and danger, is greatly lessened by the division of the bone through the vascular cancellated tissue instead of through the shaft; while the tendency to protrusion of the bone, which causes so much inconvenience in amputation in the thigh, is rendered comparatively slight by the ample extent of the covering provided, and also by the circumstance that the divided ham-strings slip up into their sheaths, so that the posterior muscles have comparatively little power to produce retraction. The superiority of the operation is equally conspicuous as regards the ultimate usefulness of the stump, which from its great length has full command of the artificial limb, while its extremity is well calculated for sustaining pressure, both on account of the breadth of the cut surface of the bone divided through the condyles, and from the character of the skin habituated to similar treatment in kneeling. Considering, therefore, that this procedure can be substituted for amputation of the thigh in the great majority of the cases both of injury and disease formerly supposed to demand it, "Carden's operation" must be regarded as a great advance in surgery.

It is also of great value with reference to the general question of the best mode of amputating in the lower limb. It confirms completely the conclusion which was, indeed, obvious enough from theoretical considerations, that there is no special virtue in the rectangular shape of the flaps advised by Mr. Teale, but that the advantages claimed for his method may be attained by much more simple means.

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[1] See On Amputation by Single Flap. By Richard Carden, F.R.C.S., etc., p. 6. This is a reprint of an article in the British Medical Journal, April, 1864.

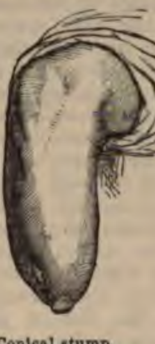
[1] Op. cit., p. 6.

Nevertheless to extend the method by anterior flap of skin alone to the thigh and leg, as advised by Mr. Carden, does not seem to me judicious. A flap of integument alone, sufficiently long to cover the entire diameter of the limb, must be liable to the risk of sloughing, and I cannot but think it wise, when the muscular element is available for the purpose, to follow Mr. Teale's example by including it in the composition of the flap. An operation thus intermediate between those of Carden and Teale, with a rounded muscular anterior flap somewhat shorter than Teale's, and compensating for its diminished length and for the absence of a posterior flap by retracting the muscles before applying the saw, was practised in the thigh by Mr. Spence, of Edinburgh, before Mr. Carden published, and yielded very good results.[1] But this operation involves as high a division of the bone as Mr. Teale's, and it therefore became an important question whether its advantages might not be attained by some method free from this objection. The essential object to be aimed at is that, while the covering for the bone shall be ample, the tender cicatrix shall be placed sufficiently far back on the end of the stump to be well out of the way of pressure between the end of the bone and the bottom of the socket of the artificial limb. And if, consistently with attaining this object, the anterior flap could be shortened and eked out with a short posterior flap, it is plain that in exact proportion to the extent to which this was done would be the length of bone gained, with corresponding diminution of danger and increase of usefulness of the stump. Now it fortunately happens, both in the calf of the leg and in the thigh, that the bone lies far forward among the muscles, so that even its posterior surface is considerably anterior in position to the longitudinal axis of the limb. Hence a flap as long as two-thirds of the diameter of the limb would ensure the scar being considerably behind the point of pressure; while a posterior flap half as long as the anterior one would be sufficient to complete the covering. The posterior flap, being short, may be made of integument only without any risk of sloughing, thus getting rid of the bulk, weight, and contractility of a posterior muscular flap. On the other hand the anterior flap, being still somewhat lengthy, should be raised so as to contain a good deal of muscle, which will be useful not only by ensuring sufficient vascular supply, but also by increasing the thickness of the cushion below the bone; while any tendency to retraction that it possesses (small compared with that of the posterior muscles) will be counteracted by the force of gravity, through which it will naturally tend to occupy its proper place.

Such was the plan of amputating which I ventured to recommend for the thigh and the calf in the first edition of this work, on theoretical grounds which subsequent experience has only tended to confirm. The details of the method, as applied to these two situations respectively, will be found described in subsequent pages.

[After amputation by any method, if the bones are not abundantly covered, and even in some cases where the amount of the soft parts preserved seems to be ample, there is sometimes so much retraction of the latter as to give rise to much trouble from is called "conical stump" (fig. 779). Especially is this apt to occur in cases where the operation is done in childhood, in the arm or thigh; the bone in subsequent years growing at the junction of the shaft with the upper epiphysis, so as to distend the soft parts, which undergo no such change. Two instances of this kind, under my care, have given great trouble. Reamputation is the only resource.

Fig. 779.



Conical stump.

When the bone is insufficiently covered, or if at the time of the operation it is roughly dealt with, or perhaps from its being divided through a portion already injured, necrosis may take place, with protrusion, as in fig. 780. Sometimes, on extraction of the sequestrum, sound healing occurs; but re-amputation is often necessary in these cases.—P.]

The dressing of the stump is a matter

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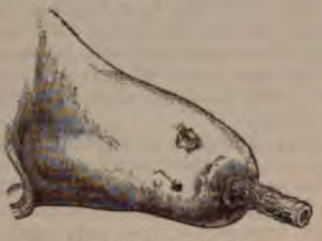
[1] Edinburgh Monthly Journal, Nov., 1859.

quite as important to the successful issue of amputation as the manner in which the limb is removed; and therefore requires special notice here.

[Fig. 780.



Necrosis in a stump.]

Various as are the methods adopted by different surgeons for the purpose, they may all be classed under two heads, viz., that which, being hitherto in general use, may be termed the ordinary mode of dressing, and the antiseptic system.

The essential principles of the ordinary mode of dressing will be best understood from a consideration of the circumstances of the wound after the operation. The mechanical irritation resulting from the passage of the instruments through the parts appears to throw a thin layer of the tissues at the cut surface into a state similar to that produced by the action of cantharides upon the skin, or tincture of iodine upon the tunica vaginalis, viz., a condition of suspended vital activity, in which, the normal relations between the blood and the living solids being interrupted, the minute vessels become clogged with the blood-corpuscles, and coagulable plasma is forced through their parietes, and flows out upon the surface of the wound.[1] The fibrin of the coagulating plasma forms the lymph which encrusts the cut surface, while its other and far larger constituent, the serum, trickling away between the lips of the wound, shows itself as the discharge which soaks the dressings during the first twenty-four hours. Meanwhile, the original source of irritation being no longer in operation, the tissues, if free from any disturbing cause, are gradually recovering their powers by virtue of their inherent vital energy; and as they regain their functions, the effusion of plasma ceases, and a process of active organization is instituted, by which the lymph is differently affected according to circumstances. If the surfaces of the wound are in juxtaposition, the lymph glues them together, and being surrounded on all sides by healthy tissue, becomes developed in a few days into a vascular structure, which constitutes a permanent bond of union between them. But if the surfaces of the wound are separated by serum pent up in the interior, immediate union is of course prevented; and the serum, putrefying through atmospheric influence, irritates the tissues and gives rise to suppuration. And even though no serum be retained within the wound, if some persistent source of local irritation be present, such as the dragging of stitches upon an insufficient covering of soft parts, or a tightly constricting bandage, inflammation will be induced in a reflex manner, through the medium of the nervous system, and, in proportion to its degree, will interfere with the process of organic development; converting what promised primary union into suppuration; or, if more severe, rendering the lips of the wound entirely inactive, incapable of producing even pus; or if still more intense, depriving them of their vitality, and causing sloughing of the stump.

Thus, while the effusion of the lymph which is the medium of primary union depends on a species of traumatic inflammation of the cut surface, the healthy organization of that lymph requires absence of any inflammation whatever; and the great object of treatment must be to place the stump in such circumstances that the tissues may be left undisturbed, to recover from the shock they have sustained and then exert their powers upon the product of their derangement.

Supposing, then, that the operation has been properly performed, so that the soft parts may meet over the bone without any tension, and that the orifices of the bleeding vessels have been carefully secured, the following simple rule will be found of universal application. Let the dressings be destitute of any irritating quality, and so arranged that the surfaces of the wound may be kept in gentle apposition throughout, while free opportunity is afforded for the escape of discharge.

The last point is of essential moment: for a flow of serum, copious in proportion to the extent of the cut surface, is, as we have seen, an inevitable effect of the operation; and though, when it has ready egress, it is probably beneficial, by washing out blood that may ooze into the wound before it has time to coagulate in the interior,[1] yet, if retained, it will prove mischievous not only by rendering union mechanically impossible in the parts where it accumulates, but by irritating the stump, through the distension which it produces, and the acrid properties which it acquires from decomposition.

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[1] See a paper, by the author of this Section, "On the Early Stages of Inflammation," Phil. Trans., 1858; also the Croonian Lectures, "On the Coagulation of the Blood," Proceedings of the Royal Society, vol. xii., No. 56.

[1] The mixture of blood and serum which stains the dressings is very often mistaken by patients for bleeding.

In the later stages of the case, it is equally necessary to provide for the free escape of discharge; for in a wound of such extent and irregularity as that resulting from amputation, we can never be secure against the formation of some pus in the interior, which, if retained, would give rise to all the evils of abscess. To guard against such an occurrence, the stump must be from time to time carefully examined. But if the operation be performed through healthy tissues, no suppuration will take place till after four days have elapsed;[1] so that any meddling with the stump before that time is unnecessary; and such premature interference does great mischief by tearing the yet imperfect and delicate uniting tissue.

The records of surgery show that a rapid cure after amputation has depended more upon the stump having been dressed in accordance with these principles, than upon the shape in which the covering of soft parts has been cut. In the original account of Lowdham's method, before quoted, Mr. Young states that the wound healed *per symphysin* in *three weeks;* and in describing the dressing, he says, "Clap a dossil of lint into the inferior part, that one passage may be open for any blood or matter that may lodge between, but of that there seldom occurreth any." The essential exit for the serum was thus provided; and it is to be remembered that Lowdham's flap was not a heavy and contractile mass of the muscles of the calf, but consisted only of the skin and fat, and therefore would lie in its place without tension.[2]

The stumps formed after Ravaton's fashion, with two lateral rectangular flaps, healed very quickly, both in his hands and those of Le Dran, who states that the cure was completed in three weeks; and accordingly we find that neither of these surgeons employed any irritating application, and that both were careful to leave the inferior longitudinal incision freely open for the escape of the ligatures and the discharges.[3] Ravaton insists especially upon this as a grand source of safety to the patient, and states that "the drain which exists below prevents any mishaps, such as swelling, inflammation, abscess, etc.; no exfoliation of the bone occurs, and the suppuration is infinitely less abundant than in the old method, both because the wound of the stump has but a small surface or none at all, and because the inferior incision allows the pus to flow freely away; and in a short time this great wound is seen to be soundly healed."

It seems strange, that after such results had been attained and clearly recorded in France, the surgeons of that country should afterwards have preferred stuffing with charpie the wound produced in amputation; and that O'Halloran, of Limerick, who wrote in 1765, and gained considerable reputation as a supporter of the flap method of amputation, while priding himself on his familiarity with the works of the French surgeons of his time, should have discredited altogether their reports of primary union, and considered that he did great service to surgery in asserting the principle that "healing by inosculation without suppuration, by an immediate coalescence, or by the first intention, is merely chimerical, and is opposite to the rules of nature."[1]

But his influence was happily effectually counteracted, as far as British practice was concerned, by the teaching of Alanson, who was a warm advocate of primary union, both after flap and circular operations. Such success attended his practice, that out of thirty-five cases of amputation of the leg and thigh at the public hospital of Liverpool, he lost not a single patient; and he tells us that "at the expiration of a month from the operation, the wound" was "either perfectly healed or less than a sixpenny-piece."[2] These results cannot be attributed entirely to good fortune; neither can they be explained by the peculiar conical form of the wound made by his oblique division of the muscles (which indeed did not occur in the leg amputations); but they are sufficiently accounted for by his after-treatment.

In the first place, he paid special attention to securing the vessels, examining the "whole surface" of the wound "with the greatest accuracy," and drawing out the vessels with the tenaculum and tying them "as naked as possible;" and, says he, "no one will assert that in a single instance I have removed the dressings before the usual time, on account of hemorrhage." Secondly, in amputations of the thigh he employed a flannel roller, fixed round the pelvis and carried circularly down the limb, "not so tight as to press rudely or forcibly, but to give an easy support to the parts;" and there is no doubt that such a bandage acts beneficially, not only by checking retraction of the soft parts, but by keeping the muscles in a state of repose, and thus preventing the disturbance of the process of union which would result from their irregular contractions. Thirdly, the edges of the skin, after his mode of operating, generally met without the slightest tension, and were retained in apposition merely "by long slips of linen or lint, about two fingers in breadth, spread with cerate or any cooling ointment," between which the serum would freely escape and soak into the rest of the dressing, which was simply "a soft tow-pledget and compress of linen, the whole retained with the many-tailed bandage," while the exit of discharge was favored by the low position in which he placed the stump, viz., about a hand's-breadth from the surface of the bed. The dressings were first changed on the third or fourth day, and he advises that this should be done "with as much tenderness as possible;" but the flannel roller was not interfered with till some time later, when the "adhesions" were "more complete."

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[1] This is the period in adults and in cool weather; in young subjects in warm weather, it is somewhat short of four days.

[2] Currus Triumphalis, p. 111.

[3] Ravaton, Traité de Playes d'Armes à feu, p. 408; and Le Dran, Gataker's translation, p. 431.

[1] O'Halloran, on Gangrene, etc., p. 220.

[2] Alanson, Preface, p. 16.

In short, the mode of dressing pursued by this excellent surgeon was in all respects truly admirable; and well would it have been for the credit of British Surgery had his successors been equally clear-sighted and judicious. But though all followed him in attempting primary union, their very anxiety to obtain it, not being supported by sound pathological knowledge, often led to entire failure. Thus Mr. Syme has informed us,[1] that when he was a dresser in the Edinburgh Infirmary, it was usual in recent wounds to bring the edges of the skin into close contact by strips of adhesive plaster overlapping at their edges, so as to allow no escape for blood or serum; and when these were removed on the fourth day, a collection of fetid pus was almost invariably found separating the surfaces of the wound. So impressed was he with the evils of this practice, that he published in 1825 a paper on the subject,[2] in which he insisted on the invariable occurrence of a flow of serum, the retention of which was necessarily injurious; so that, as he expressed it, "there can be little difficulty in perceiving why the sealing-up of wounds should be the most certain means of keeping them open;" and he pointed out, "that pressure should be directed to the bottom rather than to the outlet of the wound." This paper had a very important influence, the principles inculcated in it being afterwards infused into London practice by the late Mr. Liston, besides being steadily taught and acted on by their author in the Edinburgh school. Mr. Liston continued to the last a practice which Mr. Syme at first suggested, viz.: leaving the wound open for some hours before the final dressing, in order to obtain greater security against secondary hemorrhage. But Mr. Syme afterwards found that, except in case of extensive oozing from minute vessels, the disturbance of the wound involved in this plan was an unnecessary infliction on the patient, and if sufficient pains were bestowed upon securing the arteries, the dressing might at once be completed. This consisted of points of the interrupted suture at sufficient distance from each other to afford a free outlet for discharges, and pads of folded lint applied over the bodies of the flaps, but not extending to the lips of the wound, with a broad piece of lint over all, and a bandage applied so as to press the deep surfaces of the wound gently together through the medium of the pads; while the cutanecus margins were left free for the exit of the discharge, which was absorbed by the lint as it escaped. This dressing was left undisturbed for about four days, when union was found already pretty firm; and a similar application being afterwards repeated at intervals of two days, the discharge of pus was commonly very trifling in amount, and the cure speedily accomplished. This was the method followed during my house-surgeoncy under Mr. Syme; at the expiration of which he was able to state, that "of the last twenty cases in which he had amputated the thigh in that hospital for chronic disease, not one had died, although some of them were almost hopeless at the time of the operation, on account of the extreme degree to which they were prostrated by long-continued discharge or other causes."[1] And there can be no doubt that one great reason for this success was, that the stumps were treated on sound principles.

Stitches are preferable to strips of adhesive plaster for keeping the edges of the skin in contact, as they occupy much less room, and so oppose less obstacle to the escape of discharge; and the only objection ever urged against them, viz., that they induce inflammation round the points where they are inserted, was entirely removed by the introduction of the metallic suture, which, unlike a silk or linen thread, that becomes acrid from putrefaction among its fibres, causes no irritation whatever, unless it subjects the parts to traction, and this ought never to be the case after amputation. When applied without tension, the wire stitches may remain for any length of time, without producing more disturbance than a ring of gold in a lady's ear;[1] they consequently retain their hold for a much longer period than silk or linen, so that strapping may usually be entirely dispensed with, which greatly simplifies the dressing.

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[1] Clinical Lecture in the Lancet, March 31, 1855.

[2] Edinburgh Medical and Surgical Journal, vol. xxiv.

[1] Clinical Lecture, Lancet, April 21, 1855.

[Difficulty is often experienced in the passing of metallic sutures by reason of the "kinking" of the wire; and various forms of needle have been devised to obviate this (see note below). A very simple plan is to use a long needle set in a handle, and having the eye near the point; this can be thrust through one or both flaps, and the extreme end of the wire engaged in the eye, when by withdrawing the needle the wire is also drawn through into place.—P.]

Though a padding of some soft material suited for imbibing the discharge, and arranged according to the principles indicated above, does good by giving general support to the stump, and keeping the deep surfaces of the wound together, and so checking oozing of blood and promoting union, yet it has the disadvantage of affording a nidus for putrefaction. Accordingly, it was proposed twenty years ago by Professor Humphry, of Cambridge, to dispense with all dressing whatever, and leave the wound exposed to the air, so that crusts of inspissated blood and serum might form over the intervals between the stitches when oozing had ceased, and healing might proceed as under a scab.[2] This plan has been especially followed in conjunction with the method of arresting hemorrhage by the temporary pressure of needle or wire introduced by the late Sir James Y. Simpson, under the title of "Acupressure." [See Vol. I., p. 455.] It has been proved that even a vessel as large as the femoral artery may remain permanently occluded if a needle be pinned down across its calibre at a little distance from its cut extremity, and removed after 24 or 48 hours. The *modus operandi* is, I presume, that the irritation of the compressing needle induces the formation of a coagulum, and its adhesion to the wall of the vessel, at the point compressed, in addition to and continuous with the clot at the divided extremity; so that the plug of coagulum, thus increased in length and made more extensively adherent, becomes efficient for resisting the impulse of the blood even in so large a tube. And I may remark that, if acupressure is employed for vessels of such calibre, I believe it to be of essential moment that the needle should be so arranged as to compress the artery at some little distance from the cut end. For smaller vessels, it is sufficient that the bleeding point itself be acted on, whether by twisting with a needle introduced into the tissues beside it, or by some other of the ingenious means devised for the purpose.[1] The needles or wires, while they remain in position, fail to conduct putrefaction into the interior, like porous ligatures of silk or flax, and after their removal within the first 48 hours, the wound is left free from any foreign body. It is pre-eminently for amputation that these two methods of acupressure and absence of all dressing are applicable; for the ends of stumps can be left exposed to the air more easily than most other parts, while from their shape they are peculiarly suited for the convenient application and withdrawal of the needles. And in the hands of some surgeons, more especially Professor Pirrie and Dr. Keith, of Aberdeen, results of the most brilliant character have been attained, large wounds, like those after amputation in the thigh, healing with great rapidity without the formation of a drop of pus.[2]

There is, however, another side to this picture. During an extensive trial of acupressure in very competent hands in the Glasgow Royal Infirmary, secondary hemorrhage occurred on several occasions, and even admitting that this was in some instances due to a faulty application of the method, and especially to want of attention to the point above alluded to regarding vessels of large calibre, yet the general impression conveyed was that acupressure failed to maintain its position in the essential point of thorough efficiency as a hæmostatic means. And I doubt whether it be possible for any surgeon, after withdrawing the needle from an artery like the femoral, to leave his patient with the feeling of entire safety that he has when the vessel has been secured by ligature. Again, the needles and wires, especially when numerous, have sometimes become entangled in the wound in a very inconvenient manner; and I have heard of a case in which it was necessary to break open the entire extent of the uniting flaps before they could be extracted. But not to lay too much stress upon occurrences like this, which may have been due to mismanagement, there remains another serious drawback to the method. The primary union, which is so beautiful when it occurs, cannot be reckoned on as invariable, and if putrefactive suppuration does occur in the interior, it is apt to produce effects all the more mischievous from the want of outlet occasioned by the complete closure of the wound externally.

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[1] I am happy to be able to confirm fully the original statement made on this subject by Dr. Sims of New York, to whom the profession is indebted for demonstrating the value of the metallic stitch. For passing the wire smoothly through the tissues, a needle suggested by myself some years ago, will, I believe, be found the most convenient. It is grooved at each side, from the eye to the blunt end, these points being further from one another than in an ordinary needle. Care must be taken to hold the wire in the grooves while twisting its ends together, after which it will be found securely incorporated with the needle. It will, however, be seen from the sequel that under antiseptic management we may return with advantage from the rigid wire to stitches of more pliant material.

[2] See Med.-Chir. Trans., vol. xli.

[1] See Acupressure, by James Y. Simpson, M.D., F.R.S.E., etc.

[2] See Pirrie on Acupressure.

Hence, for my own part, I confess I should have felt in considerable difficulty, dazzled and attracted by the splendid success of acupressure in many cases, but repelled by the fear of hemorrhage or of abscess, had it not been for the introduction of the antiseptic system, which, in a different way, attains the same objects more securely.

[In the treatment of amputation, no matter what may be the character of the dressings, absolute immobilization of the stump is of prime importance, second only to arrest of hemorrhage. To carry out this important principle it is necessary to secure the stump, after the dressings have been applied, to a splint either of light wood or binder's board. The first joint above the seat of amputation should likewise be fixed: hence the splint should be so constructed as to fulfil this indication. As a consequence of immobilizing the stump, it will be found that the inflammation necessarily attending the operation will be less apt to become excessive; there will be less tendency to burrowing among the muscles, and the muscular twitchings, that add so much to the discomfort of a patient, will be effectually controlled.—H.]

The main principles of the antiseptic system are well illustrated by a case of simple fracture, say a fracture of the leg from direct violence. Such an injury, though subcutaneous, is a most severe contused and lacerated wound; and the interstices between the mangled tissues are loaded with extravasated blood. With the sole exception that the skin is not divided so as to expose the injured parts to the atmosphere, there are present in an aggravated form those conditions which we used to regard as inevitably involving violent inflammation, followed by the separation of sloughs under suppuration, with corresponding constitutional disturbance and serious attendant risk of fatal blood-poisoning. Yet, thanks to the unbroken integument, all proceeds quietly and surely towards recovery: the effused blood is absorbed; and any portions of tissue killed by the violence are similarly disposed of; while repair is effected by a process which, though more slow, in consequence of the larger amount of effete material to be worked off, is identical with that union by the first intention, which is commonly supposed to demand cleanly-cut surfaces with accurate apposition. If, therefore, the effects of atmospheric exposure could be avoided, primary union ought to occur under circumstances hitherto believed to be inconsistent with it, and our wounds, whether incised or contused, should follow the same safe and tranquil course as subcutaneous injuries.

In order that we may attain this all-important object, the first essential is that we understand clearly how the atmosphere exerts its baneful influence. If an open contused wound is treated in the ordinary way, say by water-dressing or fomentation, we know as a matter of observation that the blood within it undergoes putrefaction as if exposed to the air at the same temperature in a vessel of glass or other inert material. This fact explains the whole train of bad consequences. The products of putrefaction are irritating and poisonous substances; and, though perfectly harmless when applied to a sore covered with granulations, which constitute a protecting layer destitute of sensibility and readily excited to suppuration instead of absorption, act very differently upon a recent wound, which violently resents the contact of the poison, yet helplessly imbibes it into the circulation: the inevitable result being local inflammation and febrile disturbance. Meanwhile such portions of tissue as have been killed by the violence of the injury, instead of retaining their original bland character, and serving as pabulum for their living neighbors, become constantly more and more acrid from progressive putrefaction in their substance, and not only irritate the weakened parts in their vicinity and retard their recovery, but operate upon them with caustic effect, and thus extend the loss of vitality greatly beyond its original limits. The persistent abnormal stimulation at length gives rise to suppuration, which weakens the patient in proportion to its amount, and in severe cases often carries him off by hectic and occasionally by pyæmia.

But however clear might be our conviction of the evil effects of putrefaction in wounds, it was hopeless to try to prevent it so long as the oxygen of the air was supposed to be its cause. In small wounds, indeed, attempts had been made with varying degrees of success to exclude the air entirely, either by a crust of inspissated blood or by hermetically sealing with collodion. But in wounds of any considerable size provision must be made for the escape of blood and serum, with which the atmospheric gases, from their diffusibility, could not fail to mingle. But the problem assumed a totally different shape when it was shown, chiefly through the philosophic labors of Pasteur, that putrefaction is not occasioned by the chemical action of oxygen or any other gas, but is a species of fermentation, analogous to that of sugar under the influence of the growing yeast-plant, being brought about by the development of microscopic organisms, the germs of which, from their extreme minuteness, float in abundance in the air as constituents of its dust. This being once clearly understood, it is plain that putrefaction in wounds may be avoided without excluding the air, by dressing them with some agent capable of destroying the vitality of the atmospheric organisms, provided that it does not act with too great violence upon the human tissues. We have long been familiar with materials which poison infesting parasites without excoriating the skin, as, for example, the various washes and unguents used for killing pediculi and their ova, or sulphur ointment for the destruction of the acarus scabiei. For the purposes of antiseptic treatment, *volatility* of the germ-poison is an essential requisite, in order that the atmosphere round the dressings may be deprived of septic energy, so that no harm may arise from its introduction into the wound, which it is often quite impossible to avoid. There are many agents which fulfil the conditions of volatility combined with hostility to low forms of life, such as chlorine, sulphurous acid, benzine, creasote, and carbolic (or phenic) acid. Any one of these, as I have ascertained by experiment, may be used so as to keep a wound from putrefaction, provided it be employed with the essential object kept steadily in view, that is to say, to prevent the possibility of a single living putrefactive organism being left in the wound at the conclusion of the first dressing, or gaining access to it subsequently.[1]

Carbolic acid happened to be the first agent that I employed on this principle;

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[1] I am glad to observe that the doubts which have been thrown upon the germ theory in some quarters, which I fear have not tended to raise the scientific reputation of our profession, are being more and more dispelled as the subject is submitted to further discussion. (See, for example, Professor Huxley's Address at the Meeting of the British Association in Liverpool last year, 1870.) Among recent contributions of fact to the elucidation of this question may be mentioned Professor Tyndall's simple but beautiful proof of the existence of organic particles of dust of excessive minuteness in the air, by means of a condensed beam of light: and the equally clear ocular demonstration afforded by the same method, that even the finest particles are capable of being removed from the air by causes which Pasteur, in some of his experiments, inferred must clear it of suspended organisms, such as the action of gravity and filtration by cotton-wool. The fact last named seemed to promise valuable results in antiseptic surgery, and experiments made with this view have afforded further evidence in favor of the germ theory, which it may be well to mention here. I found that if cotton-wool, impregnated with either chlorine or sulphurous acid gas, or with the vapor of benzine or carbolic acid, was placed upon a wound or granulating sore, after washing the surface with a lotion containing the same agent, although the volatile antiseptic left the cotton in about a day, the blood or pus still effused beneath the cotton remained free from putrefaction for an indefinite time, provided that the discharge was not sufficiently copious to soak through the cotton and appear at the surface, in which case, the meshes between the fibres affording ample space for microscopic organisms to develop in, putrefaction spread within a few hours throughout the moistened part of the mass. This circumstance greatly interfered with the practical utility of the dressing, and it has since been superseded by the "antiseptic gauze," to be described in the text; but the facts seem to me important with regard to the germ theory. The cotton-wool, though it loses all chemical antiseptic virtue in a day, yet will keep out putrefaction for a month or more. It cannot possibly keep out any atmospheric gas, which is necessarily diffused freely between its fibres, and gets in for the same reason that the volatile antiseptic gets out. That which it does exclude *can* only be suspended particles of dust. It follows, therefore, as a matter of certainty, that the causes of the putrefaction through the atmospheric influence of blood or pus, in other words, such materials as the surgeon has to deal with in treating wounds, are not the atmospheric gases, but dust. And the fact that this dust is deprived of its putrefactive energy by agents which are chemically so unlike as chlorine, sulphurous acid, benzine, and carbolic acid, but which agree in having a common hostility to animal or vegetable life (I used benzine because I knew that the entomologist employs its vapor to kill insects)—this fact confirms the view that the putrefactive particles are really organisms. I commend these simple experiments with cotton-wool to the candid judgment of the reader, because, whatever may be thought of their bearing upon the allied subject of spontaneous generation, they must be allowed to afford absolute demonstration of the truth which is the foundation of the antiseptic system, viz., that putrefaction of blood or pus under atmospheric influence is caused not by the gases of the air, but by suspended particles, which can be deprived entirely of their septic energy by the vapor of an agent like carbolic acid.

and it still appears to be the most convenient for the purpose. Besides being remarkably efficient in the form of vapor, it is miscible with a great variety of different substances, such as water, the fixed oils, and various resins: and such mixtures have each its own peculiar value with reference to our object in the treatment. Water holds the particles of the acid very feebly, and therefore liberates them readily to act upon any other substance. Hence a watery solution, besides being a cleanly lotion, is very potent in its immediate action, but very transient: exactly the properties we desire for an application to a wound designed to kill once for all any septic organisms that may have lodged upon it, and then leave the tissues as free as possible from further irritation. Common resin, on the other hand, holds the acid with remarkable tenacity, and even at the temperature of the body gives it off very slowly; so that a large proportion of the antiseptic may be kept stored up in the resin in a form which acts very mildly, but for a long period. These are the qualities required for an external dressing to guard against the penetration of putrefactive fermentation from without; while the insolubility of resin in water prevents it from being washed away by the discharges. The fixed oils occupy an intermediate position as regards their hold upon carbolic acid, and there are circumstances in which they form a most convenient vehicle for it. Carbolic acid has also the advantage of being a local anæsthetic, exercising a soothing influence upon a raw surface to which it is applied; while the disagreeable smell, which at one time was a serious objection to it, has been almost entirely removed by purifying it of the stinking compounds associated with it in the crude product.

In dealing with an accidental wound, it is necessary first to kill any septic organisms introduced into it from the air or from contact with foreign bodies, and, supposing carbolic acid to be the agent employed, this is done by washing the cut surface thoroughly with a saturated watery solution (one of the acid to twenty of water); but even this is felt to be a somewhat uncertain process, because some mischievous particle, lurking in some interstice among the tissues, may possibly elude the action of the lotion, and subsequently propagate its kind and spread putrefactive fermentation throughout the wound. For it is important to bear in mind that the acid applied to the interior has no persistent antiseptic effect, but is speedily dissipated, being partly washed away by the discharge, and partly absorbed into the circulation. When, however, the wound is made by the surgeon himself in a previously unbroken integument, he has it in his power to prevent putrefactive organisms from ever entering it alive, by operating in an antiseptic atmosphere in the form of a cloud of spray imbued with the acid,[1] while the sponges are rendered harmless by wringing them out of a watery solution, the fingers of the surgeon and his assistant having been dipped in the same, and the saw and other instruments smeared with oil containing about a tenth part of the agent. The spray, when efficient, besides fulfilling its main object of rendering the first stage of the treatment secure, has the advantage of permitting us to reduce the strength of the lotion, which is then no longer required to destroy organisms lying in the recesses of the wound, but merely to ensure the aseptic character of sponges and other foreign bodies introduced into it. For this purpose as small a proportion as one part of acid to a hundred of water is sufficient, whereas, if the spray is not used, I do not feel justified in recommending anything weaker than one to forty. The milder lotion is not only a great relief to the surgeon's fingers, but saves needless irritation of the cut surface. The wound must be covered with a cloth dipped in the lotion during any periods of suspension of the spray, which should, with such exceptions, be continued throughout the entire process, including the securing of the vessels and the introduction of the stitches.

[Within the past year Prof. Von Bruns of Tübingen, and Prof. Billroth, of Vienna, have dispensed with the spray in all their operations, although in all other respects they have strictly adhered to Lister's method. To keep a wound free from infection, these surgeons thoroughly irrigate it with a carbolic solution several times during an operation if it be long, or at its termination if it be short. Irrigation is likewise used instead of the spray at each renewal of the dressings. Should further experience prove that irrigation is just as effective as the spray in preventing infection of recent wounds, the chief objection to "Listerism," as usually practised, will be removed.—H.]

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[1] I have in view a set of experiments for determining the limits of weakness of solution, and fineness of spray, that may be trusted for producing an antiseptic atmosphere. Meanwhile I can recommend for the smaller amputations the use of Richardson's apparatus for local anæsthesia, with the 1 to 40 watery solution of carbolic acid substituted for ether. This we have already proved to furnish an absolutely trustworthy spray, though probably needlessly coarse and strong. For the larger amputations a larger cloud is requisite; and I hope we may have before long a simple and cheap means for the purpose; the machine which I have had constructed for my own use, though efficient, being too cumbrous and expensive.

The antiseptic catgut ligature constitutes an important element in the system. When properly prepared,[1] it seems to fulfil all the conditions of a perfect hemostatic, combining the absolute security and universal applicability of the ligature with virtual absence of any foreign body from the wound. For if putrefaction is avoided, the knots and short cut ends are absorbed with as much certainty as the clots and pieces of dead tissue in a simple fracture, and, however numerous they may be, do not in the least interfere with primary union; while, if putrefaction chances to occur, we may guess that such of them as are actually exposed to putrescent liquids must ultimately soften down and come away, like the other minute sloughs of cellular tissue which appear along with the pus; but this is merely matter of presumption, for I have never observed the catgut knots come away, nor have I ever seen abscess occasioned by them, although I have constantly used this ligature during the last two years, and putrefaction has occurred in many cases during that period. And I may add that I have never known secondary hemorrhage caused by the use of the catgut.

Any one desirous of convincing himself of the absorption of catgut has only to employ it for sutures and treat antiseptically, and in a few days he will find the knots come off with a touch, the part of the stitch imbedded in the tissue having disappeared. This circumstance renders the catgut unfit for sutures intended to retain their hold for a considerable period, for which some material less amenable to absorption by the tissues is to be preferred, such as silk thread with the interstices among the fibres filled up with wax containing about a tenth part of carbolic acid.[1] This material is very superior to wire, not only on account of its perfect suppleness, but because its actively antiseptic character ensures absence of putrefaction in the track of the stitch. The spray is never more useful than in the introduction of the sutures. If it be not employed, the wound must be injected with lotion after the insertion of the last stitch, to destroy any mischief that may have entered through regurgitation of blood that oozes into the cavity during the sewing—a troublesome and uncertain process, which the spray enables us to dispense with entirely.

[Mr. Lister,[2] in his endeavor to simplify the preparation of the antiseptic catgut ligature, has recently devised a method by which this agent may be rendered fit for use in a comparatively short space of time. He recommends for this purpose a solution consisting of one part of chromic acid and four thousand parts of distilled water, to which are added two hundred parts of pure carbolic acid or absolute phenol. An amount of catgut equal in weight to the proportion of carbolic acid is placed in this mixture, and allowed to remain immersed for 48 hours. At the expiration of this period the catgut is removed from the solution, dried, and put in a mixture of carbolic acid and sweet oil, one to five, which will preserve it fit for use for an indefinite period.—H.]

The wound being thus free from the elements of putrefaction at the completion of the operation, it remains to carry out the other division of the antiseptic treatment, viz., to apply such an external dressing as shall securely guard for the future against the penetration of septic fermentation from without. For this purpose the most convenient material I have yet arrived at is the "antiseptic gauze," made by impregnating a cotton cloth of open texture with a mixture of carbolic acid, resin, and paraffin, in which the resin serves as the vehicle for the acid, while paraffin is added to prevent inconvenient adhesiveness.[1] This dressing, while it absorbs discharge, holds the antiseptic securely lodged in its fibres, where it is retained by the insoluble resin, and it is to this circumstance that it owes its superiority over most other porous applications.[2] It is wrapped round the stump in about eight layers, and during the first few days, while there is a copious effusion of serum, it is well to surround it with some impermeable tissue,[3] to prevent the discharge from passing directly outwards, and compel it to travel along the whole extent of the antiseptic investment, which should reach several inches up the stump. The gauze is also extremely useful in the form of antiseptic bandages, whether to check a tendency to retraction of the soft parts of a stump or for securing and completing a dressing. If strapping is required, common adhesive plaster may be rendered antiseptic by dipping it for a second or two in a watery solution of the acid, and it is most convenient to have the lotion hot (say one part of one to twenty with two parts boiling water), so that the strap is warmed at the same time by its immersion. It can then be applied effectively under the spray, which should always be used in changing the dressings of a stump till the wound has become superficial. The antiseptic atmosphere not only affords perfect security against the introduction of mischief, which it would otherwise be extremely difficult to avoid, but has the great advantage of permitting free inspection and manipulation of the stump. When the spray is intermitted, the wound must be covered with a "guard" of rag dipped in the lotion. The ends of the adhesive straps should be overlapped by the gauze, to prevent them from subsequently conducting putrefaction inwards. While discharge is free, the dressing should be changed daily; but as it diminishes, the intervals may be increased, till, when there are merely a few minims in twenty-four hours, the gauze may be left undisturbed for a week together.

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[1] It is of the utmost importance that the catgut should be rightly prepared; for, if merely imbued with an antiseptic salt, it is utterly unfit for surgical purposes, becoming soft and slippery when moistened, so that it will neither bear the requisite strain nor keep its hold when tied. But it is a happy circumstance that the animal tissue (the peritoneum with some unstriped muscular fibre from the sheep's intestine) undergoes a remarkable physical change if suspended for some weeks in an emulsion of water and oil, in which, after growing soft and opaque during the first few days, it gradually experiences an alteration of an opposite character, and at length becomes again quite transparent, and is then little affected by water, and holds better when tied than waxed silk. The emulsion is best made by mixing one part of crystallized carbolic acid, deliquesced by means of water, with five parts of olive oil. The very fine emulsion that results is placed in a covered jar having a partition of glass or other material, supported by pebbles at a short distance above the bottom, to afford space for the water that slowly subsides to accumulate in, and keep it from coming in contact with the hanks of gut which are packed loosely in the upper part of the vessel. The process of preparation goes on best in a cool place, and should be continued at least two months; and the gut goes on improving in quality for an unlimited period, if retained in the same oil. For carrying in the pocket case, I have had a narrow winder enclosed in an appendage to a metallic caustic-holder (to be had of Young or Gardner, cutlers, Edinburgh). This will receive a supply of about twelve yards, which may be kept for any time in this receptacle without losing its antiseptic virtue.

[1] The acid is mixed with melted beeswax, in which the silk is then placed, and, when thoroughly steeped, drawn out through a cloth to remove superfluous wax.

[[2] Med. Times and Gaz., Feb. 5, 1881.]

Besides these antiseptic precautions, there are two other points essential to bear in mind in carrying out the treatment, viz., to provide for the due escape of serum, and to protect healing parts from the irritating influence of the antiseptic salt. The effusion of plasma which occurs during the first few hours after the infliction of a wound is greater when the cut surface has been treated with a stimulating wash than it is under ordinary management; and unless provision be made for its escape, it will be pretty sure, in a wound of such depth and extent as that of a major amputation, to accumulate in sufficient quantity to cause inflammatory disturbance from tension. On the other hand, when once the antiseptic introduced at the time of the operation has left the wound, provided that irritation be not perpetuated by blood and serum pent up in sufficient quantity to cause disturbance, or by some other accidental circumstance exciting the nerves of the part, such as tightly dragging stitches, we may reckon with confidence on the discharge being trifling in amount. Hence it is only during the first twenty-four hours that a special provision for its escape is needed; and for this purpose I have found it convenient to lay in the wound a strip of lint soaked with an oily solution of carbolic acid (one to ten), one end being left hanging out at the most dependent part, to serve as a drain for blood and serum. This is introduced before applying the sutures, which at all other parts of the wound may be inserted more closely than is customary. The oily solution is preferred to that in water, because it greatly facilitates the extraction of "the drain," which is effected on the first or second day after the operation in a cloud of thoroughly trustworthy spray; otherwise the air that passes in to take the place of the lint would infallibly produce putrefaction.[1] If, through neglect or insufficiency of the drain, disturbance from tension should arise, it would in time, if unrelieved, cause inflammatory suppuration, which must be carefully distinguished from that occasioned by putrefaction. For if the abscess is evacuated antiseptically, whether by opening up the former wound or by a fresh puncture in the skin, there will probably be no further formation of pus, any more than in an ordinary abscess similarly treated; whereas, if the suppuration were regarded as derived from atmospheric influence, the mistake might lead the surgeon to abandon his antiseptic management altogether.

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[1] The proportions which I have found best are: 1 part of carbolic acid, 5 parts of resin, and 7 parts of paraffin. The gauze is very readily prepared by passing the cloth in several layers between a pair of rollers after dipping into a steam-heated trough containing the melted mixture. The cloth is thus left with rather less than its own weight of the mass, the individual fibres being charged, but the interstices open. Or the superfluous material may be squeezed out by a press with heated metallic plates; though this gives a less uniform result than the rollers. For hospital purposes the cloths may be washed and recharged over and over again, to save expense.

[2] Oakum acts on the same principle, and, indeed, suggested to me the idea of the gauze. In oakum, it may be remarked, the antiseptic is not carbolic acid, but creasote.

[3] The best material I know of for this purpose is a light kind of mackintosh cloth sold at all India-rubber depots, consisting of very fine calico with a film of caoutchouc on one side. Gutta-percha tissue of good quality will also answer; but it is liable to wear into holes, and so is less secure and in the long run more expensive than the mackintosh, which may be used over and over again for a long time. I find it best to place the mackintosh beneath the outermost layer of the gauze; both to prevent it from shifting its place, and for the sake of greater security antiseptically in case of any accidental perforation in the tissue.

[Dr. Neuber,[2] of Kiel, has recently invented a decalcified-bone tube, which he considers more effective as a means of draining recent wounds than all other forms of the drain. These consist of tubes prepared from ox or hare's bone, or ivory, of convenient length and calibre, which are decalcified by being immersed for ten hours in a mixture of one part of hydrochloric acid and two of water. Before being used they should be washed free of the superfluous acid, and treated with a five per cent. carbolic solution; for preservation they should be kept in five per cent. carbolic oil. Dr. Neuber asserts that a decalcified tube used as a drain in a recent wound disappears, either by being absorbed or replaced, in ten days, thus rendering an early disturbance of the primary dressing unnecessary so far as the drainage-tube is concerned.

Horse-hair, freed from oily investment by being washed in an alkaline solution, and made aseptic with a five per cent. carbolic solution, may be arranged in rolls or bundles, and used as drains. Their removal may be effected gradually by pulling out a few hairs at a time, or the entire roll may be taken out when the necessity for drainage is past.—H.]

[Chiene advocates the use of catgut treated with chromic acid, both for sutures and for drainage. He thinks we "may now anticipate a time when, with catgut stitches instead of silk, horsehair, or silver wire, catgut drains instead of India-rubber tubing, and chromic-acid gut fixing together the buttons instead of silver wire, it will not be necessary to uncover our wounds from first to last during healing; when the deep dressing need never be shifted, and when the outer dressing will only require to be removed when soaked with discharge." The mode of preparation he has hitherto found most reliable is this: He "takes a few yards of thin, common, unprepared catgut, and places it in a wide-mouthed phial containing glycerin and carbolic acid (one part of acid to seven of glycerin), and, after steeping for a week or longer, the catgut is transferred to a vessel containing chromic acid, acetic acid, and water (one per cent. of chromic, and twenty-five per cent. of acetic acid). At the end of seven hours the catgut is taken out and dried. During the drying process it is prevented from curling up, or getting rough and uneven, by using tension, the gut being stretched by winding it round two nails driven into a piece of wood, a foot or two distant from each other. In the course of a few hours it will be found ready for use. Catgut, thus prepared, is a brownish-black, perfectly smooth material, possessing great strength, yet not much thicker than what is sold in bottles as 'fine' antiseptic catgut ligature."—P.]

It is always to be remembered that the antiseptic is in itself an evil, so far as its direct influence upon the tissues is concerned. Of this we have just been considering one instance in the increased flow of serum from the cut surface, induced by the action of the lotion upon it; and it is well to recollect that the mere washing of the surface with the acid, unless followed up by strict antiseptic dressing, would leave the wound in a much worse condition as regards the chance of primary union than if had not been interfered with; so that it is better not to attempt this treatment than to do it by halves. Another example of the same thing is presented by the retardation of cicatrization observed when the acid is allowed to act immediately on the margins of the wound. Carbolic acid operates with especial energy on the cuticle; and even when far too dilute to produce excoriation, that is to say, to destroy the perfect epidermis, it will often entirely prevent the production of the young epithelial cells. It is therefore necessary to protect the cicatrizing part by interposing between it and the gauze a layer of some impermeable material. Carbolic acid is a remarkably penetrating substance, passing through gutta-percha or India-rubber with the utmost facility, though not dissolving them; and it has been somewhat difficult to devise an efficient "protective." The best we have yet obtained is oiled silk, coated on both sides with copal varnish, to render it less permeable to the acid, and afterwards brushed over with dextrin, to enable it to become uniformly moistened when dipped into a watery solution. It is thus immersed just before being laid upon the wound, in order that it may have an antiseptic film at the moment of application, to make sure that no active septic particles are put on along with it.[1] The trifling amount of the acid thus inevitably applied to the wound every time it is dressed is very soon dissipated, after which the true function of the protective comes into play;[2] and the dressing, as a whole, consisting of an antiseptic to keep out putrefaction, and an unstimulating protective to exclude the antiseptic, takes very much the place of the unbroken skin in the simple fracture, in preventing entirely the disturbing influence of external agency. Thus we have, under a moist dressing, the same mode of healing as has long been familiar in small wounds beneath a scab: and while the grievous results of putrefaction are avoided, cicatrization proceeds more rapidly than under water dressing.

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[1] If a spray-producer be not at hand, a trustworthy antiseptic atmosphere in which to withdraw the drain may be obtained by covering the region of the wound with a large piece of rag dipped in one to twenty watery solution, and extracting the lint with a pair of dressing-forceps introduced beneath the cloth. This was the method which I followed before the introduction of the spray, and with uniformly satisfactory results.

[[2] Langenbeck's Archiv, vol. xxiv., p. 314, and vol. xxv., Heft 1.]

Though the principles of this treatment have demanded a somewhat lengthy discussion, its practice will be found by no means difficult or complicated. It requires no special skill; and the care which it is essential to take soon becomes habitual and instinctive, and in the aggregate saves the surgeon a great deal of time, besides relieving him of a load of anxiety. For when a few days have passed without putrefaction, the dressings may be left unchanged for several days together, while at the same time the patient is felt to be absolutely secure against the various risks of pyæmia, erysipelas, hospital gangrene, necrosis, osteomyelitis, or exhaustion from profuse suppuration. Surely these are advantages well worthy of our best efforts to attain them.

Unhappily, however, too many cases present themselves for amputation for which this treatment is inapplicable, through the presence of sinuses occasioned by abscess from diseased bone having been allowed to open spontaneously, or having been evacuated by incision without antiseptic precautions. It would obviously be useless to operate in an antiseptic atmosphere, and employ an antiseptic dressing, if putrefaction existed in a sinus left in the stump; while to amputate above the utmost limits of sinuses or abscesses would often be quite unjustifiable. When the importance of the antiseptic management of abscesses becomes fully recognized by the profession, cases of this kind will be less common than they now are. Meanwhile, we must deal as best we may with these results of misfortune or mismanagement. And here the solution of chloride of zinc, introduced by Mr. Campbell de Morgan, possesses a very high value. This salt, when used in pretty large proportion to water, say about forty grains to an ounce, has the great peculiarity of producing a persistent antiseptic effect upon a cut surface; and, as the result of a single application, prevents the occurrence of putrefaction for days together, in spite of the immediate vicinity of active septic agency. This is perhaps most strikingly exemplified by its effects on wounds resulting from the removal of tumors of the jaws. Here the cavity of the mouth perpetually supplies fresh septic agents; yet if the raw surfaces are well brushed over with the chloride solution before the edges of the skin are stitched, the breath will remain from day to day free from the fœtor which was formerly so distressing after such operations, while a great deal of the inflammatory disturbance occasioned by putrefaction is averted. Similarly, in the case of amputation through a part affected with sinuses, if the cut surfaces are treated with chloride of zinc, the causes of putrefaction left lurking in the sinuous tracks are incapable of communicating putrefaction to the rest of the wound till three or four days have elapsed, when granulations are more or less completely formed to protect the cut surface from the evil effects of the contact of putrid material. The discharge occasioned by this application being very free, special care must be taken to leave ample room for its escape; and indeed it is sometimes best to abstain from the use of stitches altogether for the first few days: for if the serum accumulates in the stump, putrefaction occurs much earlier than it otherwise would.

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[1] Common oiled silk smeared with the oily solution will answer the purpose pretty well, especially if used in two layers. In preparing the protective described in the text, when the copal varnish has dried, a mixture of 1 part of dextrin, 2 parts of starch, and 16 parts of cold watery solution of carbolic acid, is brushed over. The granular starch enables the dextrin solution to apply itself better to the varnished surface, and the solution of carbolic acid is used rather than mere water for the same purpose. The acid soon evaporates, and leaves the protective free from stimulating properties.

[2] It is perhaps necessary to utter a word of caution against the improper use of the protective, which, if its principle is not kept clearly in mind, may be employed so as to have the most disastrous effects. All that lies beneath this layer is intended to be *aseptic*, but not *antiseptic*, and will putrefy at once if any active septic particle gains access to it. If, therefore, the protective were allowed to project beyond the gauze, it would simply serve to conduct putrefaction inwards to the wound. The protective must always be overlapped by the antiseptic dressing as freely as if it were a wound.

Before commencing the operation, an attempt should be made to correct entirely the pre-existing putrefaction in such cases. With this object, the skin having been thoroughly cleansed of inspissated discharges,[1] the sinuses should be freely injected with the chloride solution by means of a powerful syringe, the part being at the same time manipulated, in the hope that the antiseptic may be forced to penetrate to their furthest recesses. After the removal of the limb, when the cut surface has been treated with the solution, the stump is wrapped in gauze as usual, and the spray is employed in the changing of the dressings. Under this practice, a certain proportion of cases will remain entirely free from putrefaction; while in those in which it does occur, its effects will be greatly mitigated.

[Perhaps it may not be amiss to say a few words here in regard to the so-called "antiseptic" system, as advocated in the preceding pages. Those who have closely watched the course of opinion for the last few years, on this important matter, will not have failed to note that the spray, which was so strongly urged as an indispensable "germicide," has been abandoned by many who are still disciples of Lister. Putrefaction and suppuration are not, as might reasonably be supposed from some of the arguments used for Listerism, identical, or even analogous, processes. The sooner wounds can be closed and healed, and the cleaner they can be kept —the more they can be brought into a condition like that of subcutaneous tissues—the better. Rigid cleanliness, then, of hands, instruments, apparatus, and dressings, seems to be after all the sum and substance of "antiseptic surgery;" since the early and complete closure and protection of wounds is a recognized principle of rational practice, and has been so for many years.—P.]

Before considering the operations best adapted for particular cases of amputation, it will be well to allude in a general way to the necessary instruments, and the mode of using them.

The amputating knife should have a straight and strong back, and a sharp point, near which the edge should present a gentle convexity. In the old circular amputation, a curved knife with a blunt extremity was employed to divide the integument at one continuous sweep; but as the modified operation is always preferable, in which the skin is cut in the form of short semilunar flaps, this somewhat clumsy implement may now be entirely dispensed with. For a flap operation performed by transfixion, the blade should be about half as long again as the diameter of the limb; but when the soft parts are cut from without inwards, a much shorter knife will answer the purpose, and should therefore be preferred, as the movements of the smaller instrument can be directed with greater precision and speed. For removing a finger or toe, something intermediate between the tapering bistoury often used in France and the old round-bellied English scalpel will be found to combine the advantages of both, without the inconveniences of either, being equally adapted for piercing and cutting.

[The form of knife best suited for amputating a finger or toe is one invented by the late Prof. John Neill. The blade, which is about one and a half inches long and a little less than a quarter of an inch wide, is straight and sharp-pointed, and has a strong back; it is connected by a short shank with a stout handle, which enables the operator to hold the instrument with a firm grasp. For the division of the interosseous tissues, a double-edged catlin will be found most useful.—H.]

In using the knife, the young practitioner will have to unlearn some of the habits he has acquired in anatomical study. The object being now simply to divide the resisting textures efficiently, the stroking and scratching movements of the dissecting-room must be changed for a free sawing motion; and for this purpose the knife must be held firmly in the hand, instead of being kept in the feeble position best suited for the investigation of delicate structures.

There is another error to which the habits of dissection may lead, far more serious than a cramped and awkward use of the knife, viz., that of directing the edge of the instrument towards the skin in raising a flap of integument. Such a practice, necessary in anatomy, in order to leave the subcutaneous structures intact, will, if carried into amputation, most seriously endanger the vitality of the flap, which derives its supply of nourishment

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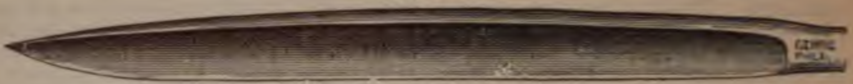
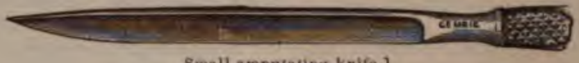
[1] I find it well in cases of this kind to have a cloth, dipped in one to twenty watery solution of carbolic acid, wrapped round the limb a few hours before the operation, at the part where amputation is to be performed, so as to make sure of thorough purification of the integument. In ordinary cases it is sufficient to sponge the surface of the skin with the lotion immediately before operating.

[Fig. 781.


GEMRIG PHILA.

Large amputating knife.

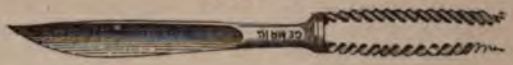
Fig. 782.



Small amputating knife.]

from vessels ramifying in the fat, and must perish if those vessels are extensively divided through scoring of the *tela adiposa*. I am satisfied that integument designed to form a covering for the stump is often made to slough for want of scrupulous attention to this simple point.

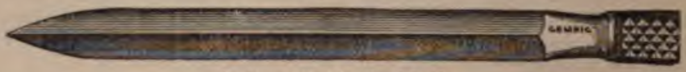
[Fig. 783.



Scalpel.]

The skin should always be cut perpendicularly to its surface, for if it is bevelled off to a thin edge, it is not only unsuited in shape for adaptation with a view to primary union, but the margin may slough for lack of nutriment.

Fig. 784.



Catlin or double-edged knife.

[Experience has shown me in numerous cases that bevelling the edges of the skin, on one flap outwards, and on the other flap inwards, gives the most admirable results in the way of rapid and firm healing, with sometimes an almost imperceptible cicatrix. When I first reported upon this matter (see New York Medical Record, May 22, 1880), I had not tried the plan in any large amputation; but since then I have done so, and have found the advantage gained to be well worth the additional trouble at the time of operating.—P.]

In transfixing a limb, the direction of the knife must of course be changed as it passes round the bone, in order that it may emerge at the opposite aspect; but it is desirable that this should be done in a continuous manner; for if the instrument be thrust in for a certain distance, and then partially withdrawn and made to follow a new track, the punctured wound first made may cause very troublesome hemorrhage, if a considerable arterial branch happen to be divided in it.

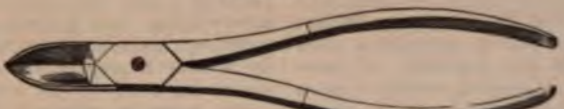
In passing the knife round a bony prominence, such as the shoulder, care must be taken to hold the limb in such a position as shall relax the parts that are to be pierced, otherwise what might be quite easy may prove impossible; and in the latter part of the process, when the point of the knife is advancing in a greatly altered direction, it is important to keep the back rather than the edge directed outwards, in order to avoid cutting the base of the flap.

In amputating at a joint, if the tissues are healthy, the division of the soft parts completes the process, there being no need to take away the articular cartilage, which is almost as favorably circumstanced for healing as vascular structures. Thus, when a finger is removed at the metacarpo-phalangeal joint, the whole wound may unite by first intention; or if suppuration occurs, the cartilage undergoes a change into granulations by a process so speedy as hardly to delay the cure.

The saw, for dividing the bone in other cases, should be broad-bladed, with a stout back, like the "fine saw" of the carpenter, and should have small but well-set teeth. In applying the instrument, its heel being placed upon the bone, previously cleared of soft parts by a circular sweep of the knife, it should in the first instance be drawn with firm pressure towards the operator, so as to make a groove which it will have no disposition to quit in the first forward stroke. The bone is thus cut precisely at the place desired, while any scratching of the neighboring parts of the osseous surface is avoided, which, besides involving loss of time, might give rise to a small exfoliation.

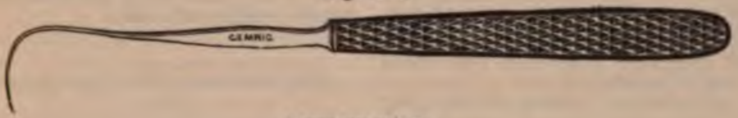
[Many surgeons forget that it is not necessary to bear any weight upon the saw, but merely to give it a steady and quick to-and-fro motion; hence when the bone is nearly cut through, they are apt to break and splinter it, and perhaps to injure the soft parts also.—P.]

[Fig. 785.



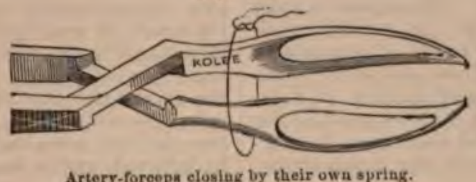
Bone-nippers.

Fig. 786.



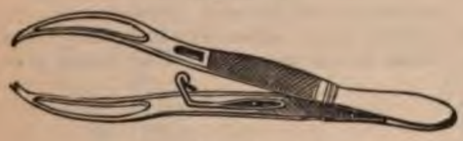
Large tenaculum.

Fig. 787.



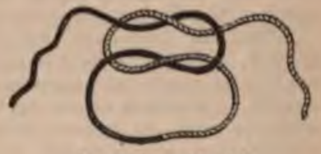
Artery-forceps closing by their own spring.

Fig. 788.



Artery-forceps.

Fig. 789.



Square or reef-knot.]

The assistant who holds the limb must take care not to press it forcibly upward, otherwise the saw will become locked; nor must he draw it downward to any great degree, or the bone will break and splinter towards the last. But the operator should always be so placed as to be able to control with his left hand the part which he removes. Should any projecting portion be left, it must be removed with a pair of *bone-pliers*, which may be substituted entirely for the saw when the bone is of very small size, as in the fingers. In using them, the flat surface should always be directed towards the parts that are to be preserved, as the other sides of the wedge-shaped blades crush the bone while they divide it.

The tenaculum, long universally employed for seizing the bleeding vessels in order to tie them, has been superseded by the *catch-forceps*, which, like the bone-pliers, were introduced into surgical practice by the late Mr. Liston. Besides being always more convenient, they have the great advantage of making the surgeon independent of an assistant in cases of emergency. The ligature should be tightly and securely tied, by reversing in the second half of the knot the relation that the ends of the thread had to one another in the former half, or, in the language of sailors, by making "*reef-knot.*" [Fig. 789.] The larger vessels should be drawn a little way out of their sheaths, as the best means of avoiding nervous trunks and other unnecessary tissue. Of the smaller branches, as a general rule, all that are seen to pulsate should be tied, mere oozing being checked by the gentle pressure of the dressing; but in order to render conspicuous all that require tying, it is safest, before dressing the stump, to put the surfaces of the wound in apposition for a short time, and bathe the integument with warm water, so as to induce relaxation of contracted arteries, which might otherwise cause secondary hemorrhage. If, however, the antiseptic treatment be adopted, the stimulating influence of the lotion causes sufficient determination of blood to the part to render conspicuous any vessels that require ligature. In connection with the antiseptic system, torsion was revived a few years ago by Mr. Syme, who employed it sometimes even for arteries like the femoral. I have myself frequently twisted vessels of such magnitude, and the applicability of the method to them has been since further demonstrated, especially by Mr. Bryant and Mr. Cooper Forster.[1] But though torsion must always hold its place as a valuable means of arresting hemorrhage, the antiseptic catgut ligature will, I believe, be found, as a general rule, more simple and efficient.

[A very effectual means of checking general oozing from the cut surface of a stump after the principal vessels are ligatured, is water at a temperature varying from 115° to 140° F. This agent is most conveniently brought in contact with bleeding surfaces by means of compresses or large sponges. These are to be wrung out of hot water and quickly laid on the part, where they may be retained for a minute or two; and should the first application fail to stanch the hemorrhage, they may be reapplied. Hot water is a valuable hæmostatic in cases of obstinate bleeding, consequent upon the employment of the Esmarch apparatus.—H.]

When the *tourniquet* [fig. 772] is employed, it should be kept loose till the operation is about to commence, when it should be screwed up as rapidly as possible, to avoid an intermediate degree of constriction, which would check venous return without preventing arterial flow, and produce engorgement of the limb with blood which would be lost to the patient. For the last few years I have pursued with great advantage the practice of emptying the limb of venous blood by elevating it to the utmost, and having it pressed firmly from the extremity towards the trunk, just before the tourniquet is tightened. By this means the operation is rendered almost bloodless; and when a limb previously gorged with blood, from preternatural vascularity, is removed from an emaciated subject, the patient is left with actually a larger proportion of the vital fluid in his vessels than he had before the operation. In some cases it is wise to apply a bandage tightly from below upwards, while the patient is under chloroform, so as to force the blood out of the part to be removed, and save it to the circulation.

In cases in which the tourniquet is inapplicable, digital compression must be trusted to for preventing hemorrhage during the operation. The strength of the assistant on whom this duty devolves is often early exhausted by unnecessary exertion; for the current through an artery lying over a bone, or some other resisting texture, is completely arrested by a very moderate amount of pressure directed exactly to the proper part.

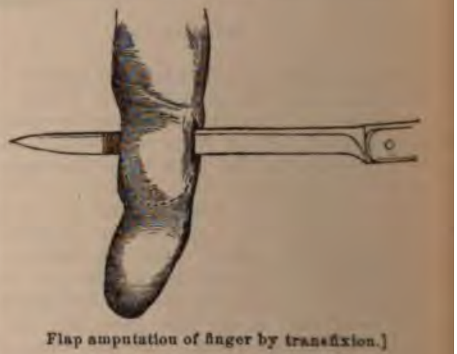
[In cases in which it is highly desirable to save every drop of blood, the part to be removed may be rendered exsanguineous by the application of the Esmarch bandage before the ordinary tourniquet is adjusted.—H.]

Amputations in the Upper Extremity.

The upper limb, independently of its smaller size, involving less shock to the system from the operation, is more favorably circumstanced for amputation than the lower, in consequence, apparently, of its possessing a better vascular supply and superior vital power. Thus, to take away the arm at the shoulder-joint is a much safer proceeding than to cut off a leg below the knee, even though a larger wound be inflicted, and a larger portion of the body removed, in the former case than in the latter.

The particular amputations in the upper extremity will be most conveniently considered in the order in which they occur from below upwards. The distal phalanges, though very liable to injury and disease, rarely require amputation; for the removal of crushed portions of bone in the former case, or exfoliation in the latter, will generally leave a useful end to the finger. If it be wished, the phalanx may be readily taken away by opening the joint across its dorsal aspect, and,

[Fig. 790.



Flap amputation of finger by transfixion.]

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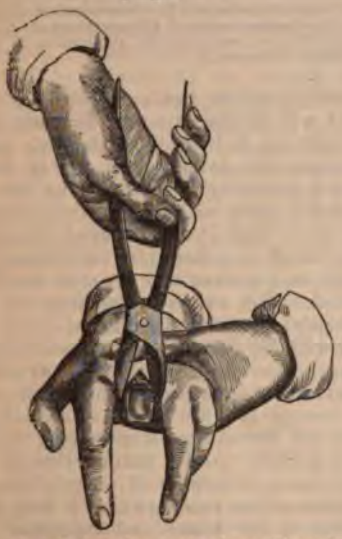
[1] See Medical Times and Gazette, March 11, 1871.

after getting the knife around the base of the bone, forming a palmar flap, by cutting from within outwards. Or the palmar flap may be first cut by transfixion; and this being held up by an assistant, the operation is completed by cutting straight through the articulation. If the whole distal phalanx be crushed, amputation through the second phalanx will be best performed by cutting from without inwards two rounded lateral or antero-posterior flaps, and dividing the bone with pliers.

Removal of the entire finger is generally preferable to leaving the first phalanx by itself, which, besides being unseemly, would be a mere incumbrance, except in the index finger; and even there it is of service only in some few handicrafts. For the middle, or the ring finger, the operation is best performed according to the following definite rule. The adjoining fingers being held aside by an assistant, the surgeon cuts from the prominence of the knuckle in a straight line towards the middle of the web on one side; but, just before reaching the web, carries the knife inwards to the fold between the finger and the palm, and, after making a similar incision on the other side, accomplishes the disarticulation. The edges of the skin will be found to meet exactly on approximation of the adjoining fingers, which should be kept tied in that position, to avoid disturbing the process of union.

[Fig. 791.



Amputation of an entire finger (Skey).]

Remarkably little deformity results from this operation, so that removal of the head of the metacarpal bone for the sake of appearance is quite uncalled for. If, however, it is at any time necessary on other grounds to take away a portion of the metacarpal bone, this can be readily done by the same method, except that the incisions are made to start from the place on the back of the hand where the bone is to be divided by the cutting pliers.

The index finger may be removed in a similar manner, care being taken, in making the incision on the side next the thumb, to carry the knife from the point of the knuckle in a longitudinal direction to near the level of the web between the fingers, before sloping it off towards the palm, otherwise the flap will be insufficient to cover the raw surface. A preferable method, however, is to make dorsal and palmar flaps of rounded form, by cutting from the web between the fingers to a point on the opposite side of the articulation at a sufficiently high level to allow the end of the metacarpal bone to be taken off obliquely, with pliers, so as to get rid of what would cause an unseemly prominence. But if it be necessary to remove a considerable portion of the metacarpal bone, the former method, with the dorsal part of the incision extended upwards, will be the best.

Similar rules apply to the little finger, and, in cases requiring it, the whole metacarpal bone may be removed, by commencing the incision a little above the articulation with the *os unciforme*, so as to give space for dividing the ligaments after clearing the bone of the muscles which surround it.

Any portion of the thumb is valuable for opposition to the fingers, but, if necessary, the whole of it may be taken away by cutting in a curve, with the convexity downwards, from the web connecting it with the fore-finger to the opposite side of the joint, both on the dorsal and palmar aspects, raising the rounded flaps, and disarticulating. The whole metacarpal bone may be removed along with the thumb on a similar plan, by entering the knife a little above the articulation with the trapezium, and cutting first longitudinally, and then with a gentle curve to the web, on each side of the bone, then dissecting up the flaps, and dividing the ligaments of the joint.[1] This operation has been often performed for tumor of the metacarpal bone; but from a case published by Mr. Syme, it would appear that under such circumstances a useful thumb may be preserved by excising the bone affected.[1]

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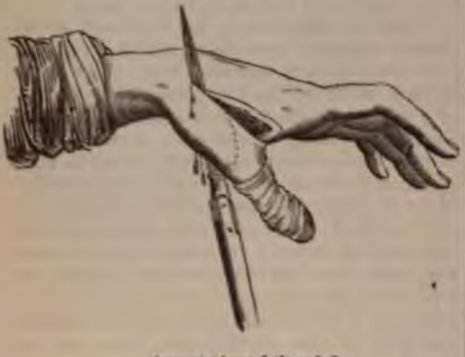
[1] For removing the thumb or little finger with the metacarpal bone, other modes of operating, somewhat more rapid, but in other respects disadvantageous even when applicable, were recommended before the introduction of anæsthesia. At present it appears only necessary to mention such as are calculated to give the best results.

The thumb alone or a single finger, being far more useful than any substitute, should always be retained if possible in cases of injury; an artificial hand being afterwards used, provided with a claw, against which the single digit left may be pressed so as to hold objects firmly.

[Fig. 792.



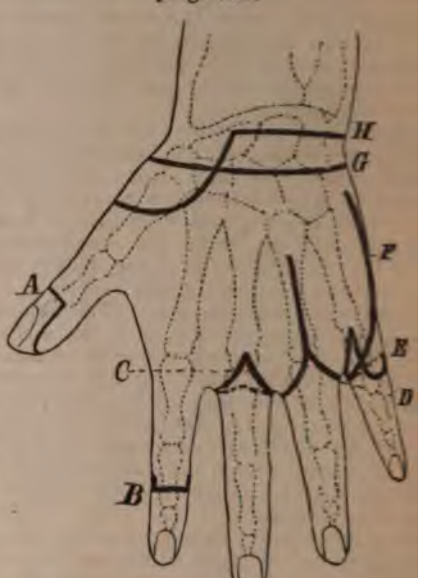
Amputation of thumb.]

Circumstances would occasionally admit of amputation at the wrist-joint, supposing this a desirable procedure. But of its two alleged advantages over amputation in the forearm, viz., the retention of pronation and supination, and a longer stump, the former, supposing such movements of an artificial limb to be desirable, would probably be often prevented by fibrous union between the radius and ulna, while the latter is found by the instrument-makers to encroach upon the space required for adapting the artificial limb. The operation, if desired, may be performed by cutting across the back of the wrist from one styloid process to the other, in a line presenting a slight concavity downwards, in accordance with the form of the articulation, opening the joint on its dorsal aspect, then shaping a rounded flap on the palm, raising it to the joint, and disarticulating. Another method is to cut the palmar flap from within outwards after disarticulation; but the prominence of the pisiform bone prevents this from being satisfactorily accomplished.

[Fig. 793 will serve to show convenient lines of incision for the various amputations of the fingers, and for that at the wrist.—P.]

Amputation in the forearm may be performed by antero-posterior flaps. In front, where the muscles are in larger amount, transfixion may be adopted; but behind, the presence of the two bones prevents this, except near the wrist, wher it may be effected, provided the soft par have their natural laxity, by pinching u the skin, and passing the knife as close t the radius and ulna as possible, when after the integument has fallen back t its usual position, the extremities of the wound will be placed so far forward that the knife can be introduced through them in forming the anterior flap. [Fig. 794.] But it is probably always well to cut the dorsal flap from without inwards, and to raise it so that it shall consist chiefly of integument, in order that redundancy of muscle and consequent tension may be avoided. The surgeon, standing on the (patient's) left side of the limb, and holding it with the dorsal surface towards him, enters the knife a little to the palmar side of the bone that is the further from him, and cuts through the skin and fat so as to shape a rounded dorsal flap, terminating the incision a little to the palmar side of the nearer bone, where he at once pushes in the point of the knife, so that it may pass in front of the bones and emerge at the place where the operation was commenced, and cuts a fleshy palmar flap from within outwards. He then dissects up the dorsal flap; and the soft parts being drawn back by an assistant, clears both bones thoroughly about three-quarters of an

[Fig. 793.



Lines of incision for amputation of wrist and fi gers. A disarticulation of phalanx, anterior flap; B, amputation in continuity, circular; C, metacarpo-phalangeal disarticulation: D, amputation of a metacarpal bone in continuity; E, disarticulation of little finger; F, disarticulation of fifth metacarpal; G, amputation of wrist, circular; H, amputation of wrist (Dubreuil). (Stimson.)]

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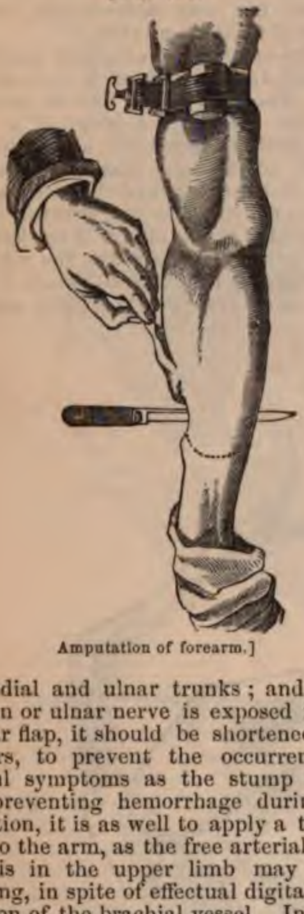
[1] Observations in Clinical Surgery, p. 38.

inch higher up, and applies the saw. The interosseous artery, which is apt to retract beside the unyielding interosseous membrane, must always be secured, as well as the radial and ulnar trunks; and if the median or ulnar nerve is exposed in the palmar flap, it should be shortened with scissors, to prevent the occurrence of painful symptoms as the stump heals. For preventing hemorrhage during the operation, it is as well to apply a tourniquet to the arm, as the free arterial anastomosis in the upper limb may cause bleeding, in spite of effectual digital compression of the brachial vessel. In muscular subjects, the modified circular operation will afford better results.

[Fig. 794.



Amputation of forearm.]

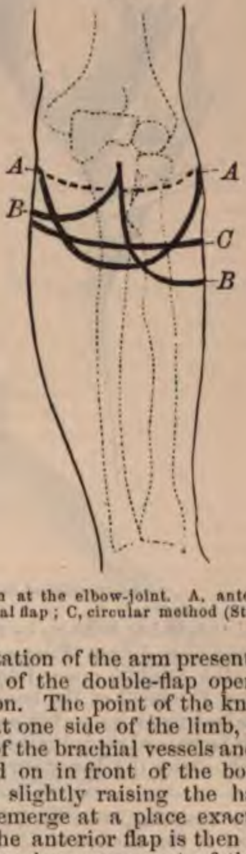
There is no objection to amputation at the elbow-joint, in cases adapted for it. [It is very desirable, whenever it can be done, to save even a small portion of the forearm, on account of the great advantage this gives in the adaptation of an artificial substitute.—P.]

The most eligible plan is to cut a large anterior flap from within outwards, after transfixing the partially-extended limb in front of the joint, bearing in mind that the line of the articulation is oblique to the axis of the humerus, and is considerably further below the internal than the external condyle. The flap being then held up by an assistant, the points of transfixion are connected posteriorly by a semicircular stroke of the knife, which, besides dividing the integument, probably detaches the radius, and a few touches with the point of the instrument will sever the connections of the ulna. The assistant should keep the skin of the back of the arm drawn upwards during the operation.

[In amputation at the elbow-joint many surgeons are in favor of preserving the olecranon process. This may be done by sawing it off flush with the incision of the integument in the posterior aspect of the elbow, in the operation described in the text. As a consequence of leaving this process in the posterior flap, the attachment of the triceps muscle is left undisturbed, hence the patient will have greater command of the movements of his stump, and of an artificial limb should he wear one.—H.]

[Fig. 795 represents the various methods of amputation at the elbow.

Fig. 795.



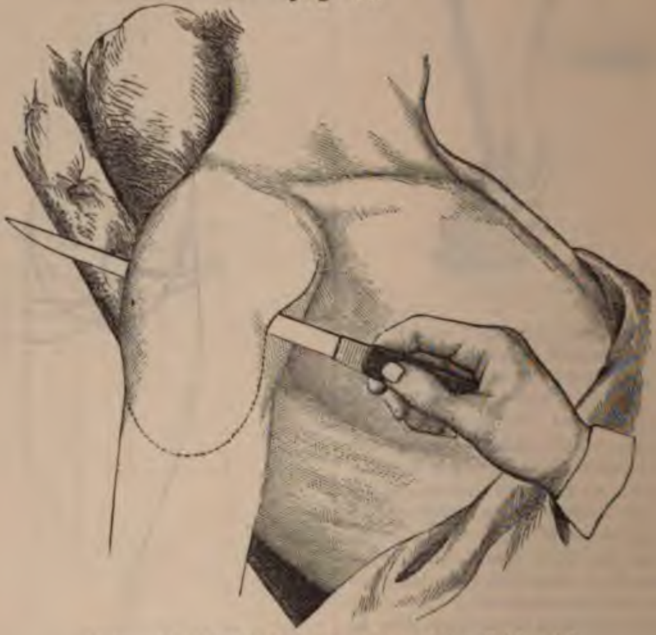
Amputation at the elbow-joint. A, anterior flap; B, external flap; C, circular method (Stimson).]

Amputation of the arm presents a good example of the double-flap operation by transfixion. The point of the knife being entered at one side of the limb, avoiding the site of the brachial vessels and nerves, is pushed on in front of the bone; and then, by slightly raising the handle, is made to emerge at a place exactly opposite. The anterior flap is then cut with a brisk sawing movement of the instrument, which is first directed longitudinally for a short distance, and then turned gradually towards the surface, and brought out perpendicularly to the integument. The flap is now lightly raised by the assistant, without any traction, for this would interfere with transfixion behind the bone, which is effected through the extremities of the wound already made, and the posterior flap is cut like the anterior. The assistant now retracts the flaps firmly, when a circular sweep of the knife exposes the bone about an inch above the angle of union of the flaps, and another similar turn of the instrument prepares it for the application of the saw. The edges of the wound meet accurately when brought together, producing a symmetrically rounded stump. But when the muscles are largely developed, it is well to avoid the inconvenience occasioned by their redundancy, by cutting the flaps from without inwards, or by employing the modified circular method.

Amputation at the shoulder-joint is an operation which yields very satisfactory results, as was strikingly shown by the experience of the late Baron Larrey, who, during the wars of the first Napoleon, saved ninety out of a hundred cases, in spite of the very unfavorable circumstances of military practice.[1]

Of the various methods that have been proposed, that of Lisfranc is most expeditious. The arm being raised so as to relax the deltoid, the point of a long-bladed knife is introduced about midway between the coracoid and acromion processes, and thrust round the outer side of the joint till it comes out within the posterior fold of the axilla (or if the left limb be the subject of operation, the direction of transfixion is reversed), when a large muscular external flap is rapidly cut [fig. 796]; and this being held up by an assistant, and the arm drawn downwards and forwards, the joint is opened by cutting firmly upon the head of the bone,[1] which is then raised from its socket so that the knife may be passed round it, and carried downwards along the inner surface of its neck and shaft, followed by the other hand of the assistant, which grasps the tissues that lie between the track of the instrument and the axilla [fig. 798], so as to prevent bleeding from the main artery, when it is divided in the completion of the short internal flap. [Fig. 799 shows the result in a successful case.]

[Fig. 796.



Amputation at the shoulder-joint by transfixion (Erichsen).]

This operation, however, is rarely available in practice. Its satisfactory performance requires the leverage of the humerus, which is generally broken in cases of injury demanding removal of the limb, in which also the parts necessary for the large external flap are often encroached on; and in tumor of the bone, which is the other affection that most frequently calls for amputation in this situation, transfixion becomes impossible.

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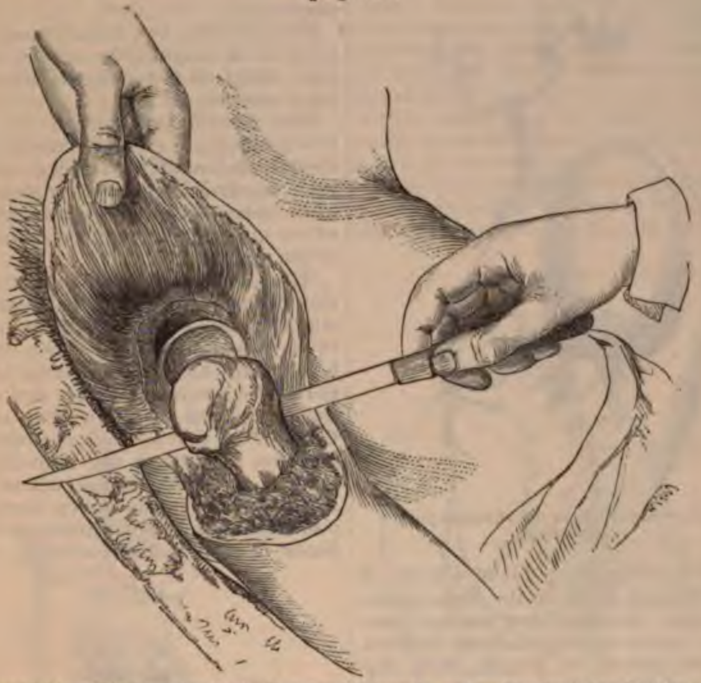
[1] Strictly speaking, this is Dupuytren's modification of the method of Lisfranc, who depressed the arm at the commencement of the operation, and opened the joint during the transfixion; but this was a less easy proceeding, though shorter by a few seconds in very expert hands.

[1] Mémoires de Chirurgie militaire, par le baron D. J. Larrey, tome iv., p. 434.

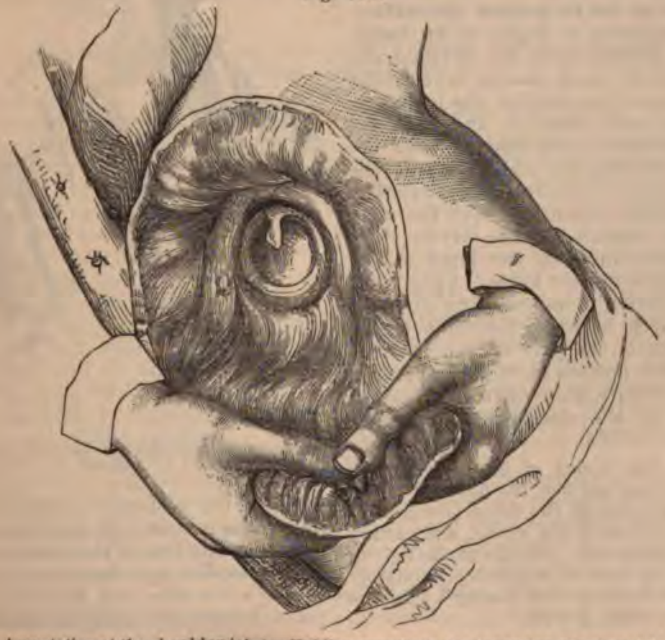
On the other hand, Larrey's mode of

[Fig. 797.



Amputation at the shoulder-joint. Opening the capsule, and making inner flap (Erichsen).

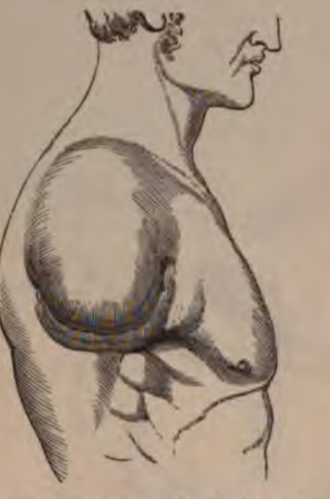
Fig. 798.



Amputation at the shoulder-joint. Holding vessels in the inner flap (Erichsen).]

operating, by lateral flaps of equal size, proved almost always applicable in his cases of gunshot wound, while it was as secure against hemorrhage as that of Lisfranc. Thrusting the point of a knife of moderate length down to the bone immediately below the acromion process, Larrey first made a longitudinal incision about two inches in length, from the extremity of which he cut in a curved line at each side of the limb to the fold of the axilla; then dissected up the muscular flaps so as to expose the articulation completely, a finger of an assistant being placed upon the divided circumflex artery: and, having severed the connections of the head of the humerus, passed the knife round it, and kept the instrument close to the inner side of the bone, till, turning the edge towards the surface, he last of all divided transversely the tissues intervening between the axillary folds, containing the artery, previously commanded by the hand of the assistant following the knife.[1] [Fig. 800.]

[Fig. 799.



Stump after amputation at the shoulder-joint (Erichsen).]

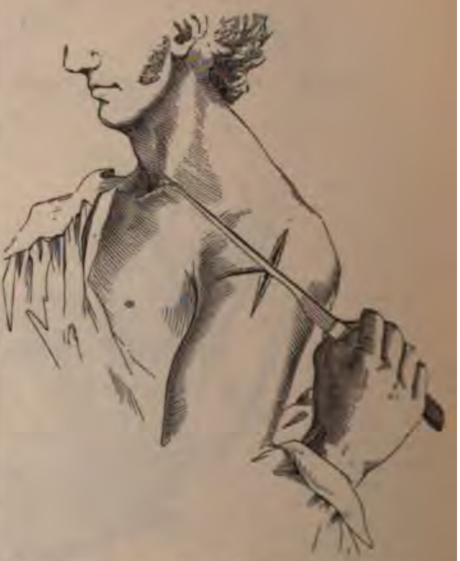
This operation is improved by dividing the structures between the folds of the axilla obliquely, as part of the internal flap, the lower portion of which is reserved to be cut from within outwards, at the conclusion of the operation: the result being two precisely similar semilunar flaps, meeting above at the acromion and below at the posterior fold of the axilla, adapted for immediate union throughout their length, and presenting as small a wound as is consistent with an efficient covering.

[Prof. Spence has recently introduced a method of amputating at the shoulder-joint which is somewhat similar to Larrey's method.

The advantages alleged in favor of this method are greater care in effecting disarticulation of the head of the humerus; the division of the terminal branches of the posterior circumflex artery instead of the main trunk; and the better shape of the stump.

The following is Prof. Spence's description of the operation. "The arm being slightly abducted, and the humerus rotated outwards, I cut down upon the head of the humerus immediately external to the coracoid process, and carry the incision down through the clavicular fibres of the deltoid and pectoralis major muscles, till I reach the humeral attachment of the latter muscle, which I divide. I then with a gentle curve, carry my incision across and fairly through the lower fibres of the deltoid toward, but not through, the posterior border of the axilla, unless the textures be much torn. I next mark out the line of the lower part of the inner section by carrying an incision, through the skin and fat only, from the point where my straight incision termi-

Fig. 800.



Amputation at shoulder by Larrey's method (Malgaigne).

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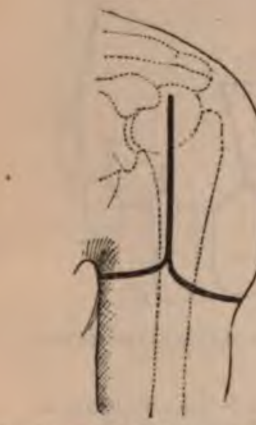
[1] During one period of his practice, he formed the lower parts of the flaps by transfixing from the end of the longitudinal incision to the borders of the axilla, and cutting from within outwards; but the method given in the text is that to which he ultimately gave the preference. See Larrey's Clinique Chirurgicale, 1829, p. 563.

nated, across the inside of the arm to meet the incision at the outer part. If the fibres of the deltoid have been thoroughly divided, the flap, together with the posterior circumflex artery, can be easily separated by the point of the finger from the bone and joint, and drawn upwards and backwards so as to expose the head and tuberosities without further use of the knife. The tendinous insertions of the capsular muscles, the long head of the biceps, and the capsule are next divided by cutting directly on the bone. Disarticulation is then accomplished, and the limb removed by dividing the remaining soft parts on the axillary aspect. Fig. 801 shows this method."—H.]

When the bone is broken near the joint, it will be found useful to adopt Mr. Syme's expedient of introducing the finger into a longitudinal wound in the capsule, for the purpose of drawing down the head of the bone so as to gain access to its attachments. In some cases of tumor it may be necessary to raise all the soft parts, including the axillary vessels, from without inwards; when hemorrhage must be restrained by compression of the subclavian artery over the first rib, by the thumb of an assistant pressed down behind the collar-bone.

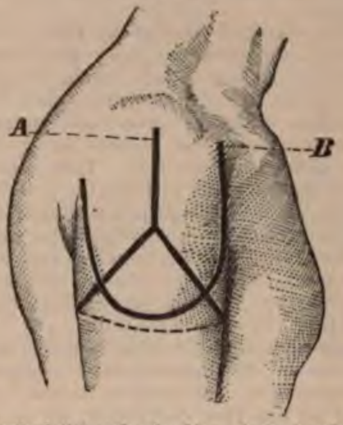
[When the subclavian artery cannot be readily controlled by digital compression over the first rib, the handle of a large door-key wrapped with a few turns of a narrow roller will be found a good substitute for the finger.

[Fig. 801.



Disarticulation at shoulder. Spence's method (Stimson).

Fig. 802.



Disarticulation at the shoulder. A. Oval method. B. Method by double flaps (Stimson).

Prof. Agnew suggests that the axillary artery in its third part be temporarily secured between a stout acupressure pin passed beneath the vessel, and a few turns of a thread looped over the projecting extremities of the pin.—H.]

Sometimes it may be best to make a large superior flap, cut from without inwards, containing the whole width and chief length of the deltoid muscle; but circumstances will often arise in which no regular rule can be followed, and the parts that happen to be sound must be turned to the best advantage, according to the judgment of the operator. Even when a large raw surface is left, the granulating process will complete the cure, as is well illustrated by some of Larrey's cases, which terminated satisfactorily after extensive loss of the soft parts of the shoulder and removal of portions of the scapula.

[Fig. 802 shows the methods of Larrey and Lisfranc, for disarticulation at the shoulder.—P.]

Amputations in the Lower Extremity.

The distal phalanx of the great toe may be removed in the same way as that of a finger. When one of the smaller toes is in a condition requiring amputation at all, it should be taken away entirely, since any portion left would be likely to prove inconvenient from being tilted upwards. The operation is exactly similar to that for a finger; but it must be borne in mind that the articulation with the metatarsal bone, which is the starting point for the incisions, is much further behind the web than the corresponding joint in the hand, in proportion to the size of the digit.

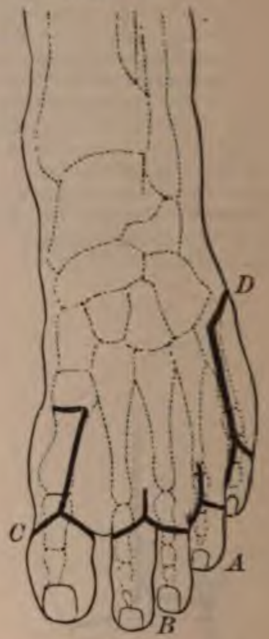
When the whole great toe is removed, or the little toe, the prominent part of the head of the metatarsal bone must be cut off by an oblique application of the bone-pliers, as it would prove inconvenient if left. The longitudinal part of the incision in the soft parts should be placed on the dorsum of the foot, to avoid the inconvenience that might arise from pressure on a scar at the lateral aspect. In amputating the great or little toe, together with the whole metatarsal bone, it is best to proceed as in the analogous operation for the little finger, the incision being commenced on the dorsum of the foot, about a quarter of an inch behind the articulation with the tarsus, and carried longitudinally to near the metatarso-phalangeal joint, where it bifurcates to embrace the root of the toe. The knife, which should be a strong one, is then applied with a short sawing action close to the metatarsal bone and its articulation with the toe, so as to clear them completely, and the ligamentous attachments of the base of the bone are lastly divided with the point of the instrument.

In the case of the great toe, it is especially important to keep the knife well under command, and avoid thrusting its point deeply into the sole; for this, besides inflicting unnecessary punctures, may wound the plantar artery at a part difficult of access. This mode of removing the great or little toe and its metatarsal bone, though not so rapid as that of dissecting up a flap from the side of the foot, then cutting between the toe to be removed and the adjoining one, and disarticulating, has the great advantage of avoiding any scar in the sole.

If more metatarsal bones than one require removal, the incision must be begun in the same way, but made to include the roots of all the toes concerned, so as to form a dorsal and a plantar flap; and even in case of caries in the articulation between the tarsus and metatarsus at one side, a useful foot may be left after taking away the bones affected, by means of a similar incision commenced further back.

The separation of the whole metatarsus from the tarsus is an operation seldom called for; but it is evident, from the account given by the late Mr. Hey, of Leeds,[1] who introduced it, that it affords excellent results. When the state of the soft parts permits, the ends of the exposed tarsal bones should be covered with a long flap from the sole, turned up to unite with the dorsal integument, cut very short; so that the cicatrix, being on the upper part of the foot, may be out of the way both of pressure in walking and of contact with objects in front of it. In performing the operation, it must be remembered that the tarso-metatarsal articulations are not in a regular line, but that the base of the second metatarsal bone is locked between the first and third cuneiform bones, of which the former is the more prominent, and is connected laterally with the second metatarsal by a very strong interosseous ligament. To divide this ligament, Lisfranc adopted the plan of thrusting an amputating knife obliquely downwards and backwards between the first and second metatarsal bones into the substance of the sole, the tissues of which served as a fulcrum, supporting the point of the instrument, when its edge was urged forcibly between the bases of the bones by pushing the handle backward. This, however, is a needlessly rough proceeding; for by pressing firmly back between the bases of the bones a strong and short knife, such as ought to be used for the rest of the operation, the ligament may be cut without difficulty; after which all the articulations are readily separated by scratching through the dorsal and other ligaments with the point of the knife, while the metatarsus is strongly depressed.

[Fig. 803.



Amputation of the toes and metatarsal bones (Stimson).]

[Fig. 806 shows the line of division between the tarsal and metatarsal bones, followed in Hey's operation, while that of Chopart's, between the astragalus and calcaneum behind and the scaphoid and cuboid in front, may be seen in Fig. 807. (In both cuts the left foot is the one represented.)—P.]

The secret of facility in the operation

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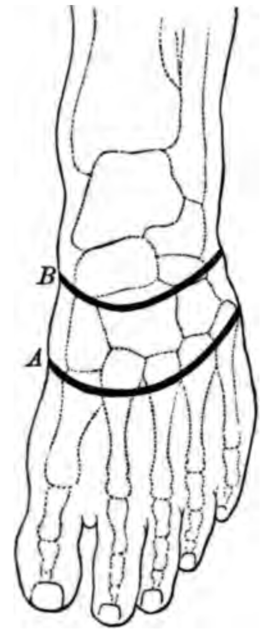
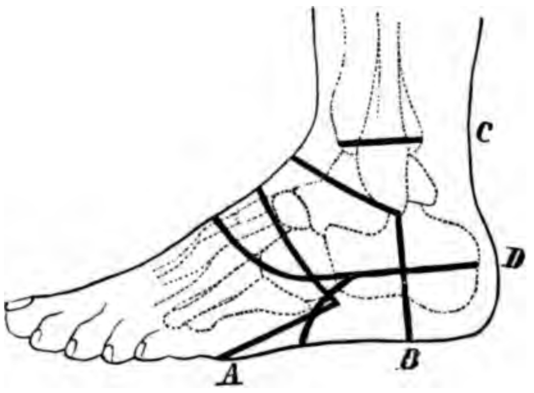
[1] Hey's Observations, p. 555.

[Fig. 804.



A. Lisfranc's amputation. B. Chopart's amputation (Stimson).]

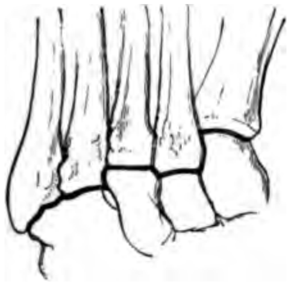
[Fig. 805.



Outer side. A. Chopart's amputation. B. Syme's amputation. C. Line of section of bone in Syme's amputation. D. Subastragaloid amputation (Stimson).]

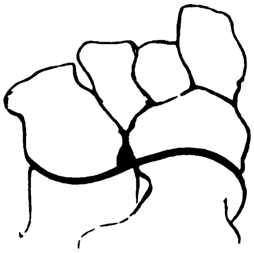
lies in hitting the line of the articulations; but this is readily enough done by finding first the joints of the first and fifth metatarsal bones, and bearing in mind that the others lie in a line between them, slightly convex forward, interrupted by the recession of the second bone. The prominence of the base of the fifth metatarsal indicates the situation of its joint, and, if the parts be in a natural condition, the articulation of the first metatarsal with the first cuneiform can also be felt. Should inflammatory thickening obscure the position of the latter, it might be well to measure the distance of the corresponding joint from the internal malleolus on the sound foot; or assistance may be derived from the circumstance that the joint lies midway between the malleolus and the metatarso-phalangeal articulation.

[Fig. 806.



Line of Hey's operation (Erichsen).]

[Fig. 807.



Line of Chopart's operation (Erichsen).]

These points having been precisely ascertained, the surgeon grasps the fore part of the sole with his left hand, placing the tip of the forefinger at one of the joints, and the thumb at the other, to mark their position, and cuts firmly across the dorsum of the foot in a line slightly convex forward, a little anterior to the articulations, taking care that the incision commences and ends fairly in the sole. He then opens the joints of the first and fifth metatarsal bones, so as to ensure finding the line of the articulations afterwards, and next shapes a long plantar flap by an incision extending from the extremities of that already made along the sides of the foot and roots of the toes, dissects up the flap from the bones, and completes the disarticulation in the manner above described.

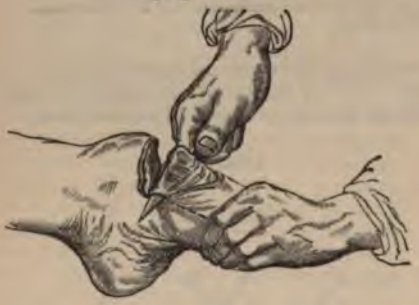
When the anterior part of the sole is unsound, a shorter plantar flap and a proportionally longer dorsal one may be made, as recommended by Sir Astley Cooper.[1]

Sometimes the proceeding may be greatly simplified by sawing through the metatarsal bones a little anterior to their bases, and so avoiding disarticulation altogether. This method would probably have another advantage, from making the stump of the foot longer, and therefore a more effectual lever for opposing the muscles which act upon the calcaneum through the tendo Achillis; for experience has shown that when the foot is much shortened, the heel is apt to be drawn up, so as to cause the end of the stump to point more and more towards the ground, producing lameness or entire inability to walk. This has been noticed especially after Chopart's amputation through the tarsus, which is consequently an undesirable operation, even in cases of injury; while in caries it is further objectionable, because the part of the tarsus left behind, though apparently sound at the time, may become affected with the same disease at a later period.

[Dr. S. F. Forbes,[1] of Toledo, Ohio, has lately introduced an amputation of the foot, which he claims is superior to Hey's or Chopart's. In this operation the flaps are made as in Chopart's, but the separation of the bone is accomplished by disarticulating the three cuneiform bones from the scaphoid and sawing through the cuboid bone in a line with the articulation of the scaphoid and cuneiform bones.—H.]

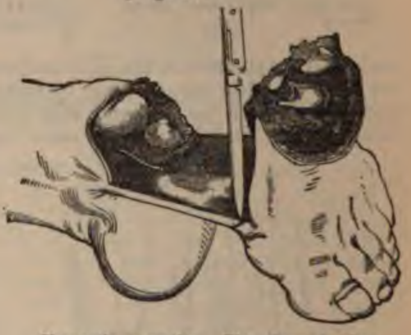
If it be wished, however, Chopart's operation may be performed on the same principle as Hey's, by making a very short dorsal flap, and a plantar one reaching to the balls of the toes, to cover the exposed anterior surface of the astragalus and os calcis. The articulation between them and the navicular and cuboid bones will be found in a line running across the foot, through a point midway between the external malleolus and the base of the fifth metatarsal bone.

[Fig. 808.



Chopart's amputation (Bryant).]

[Fig. 809.



Chopart's operation. Flap formed after disarticulation (Erichsen).]

In the amputation at the ankle devised by Mr. Syme, the bones of the leg are divided just above the bases of the malleoli; a covering for the osseous surfaces being provided from the integument of the heel; the result being a stump admirably fitted for bearing the weight of the body. At the same time, the parts likely to originate carious disease are completely got rid of; so that this operation is calculated to supersede entirely that of Chopart, besides taking the place of amputation of the leg in the majority of the cases formerly supposed to demand it.

The operation should be performed as follows [Figs. 810, 811, and 812]. Provision being made against hemorrhage from the anterior and posterior tibial arteries, by the pressure of the thumb and finger of an assistant, placed respectively on the middle of the fore part of the limb and behind the tibia, about two inches above the joint, or by a tourniquet applied in the same situation [or to the artery high up in the thigh], and the foot being held at right angles to the leg, the surgeon puts his left hand behind the heel, with the finger and thumb on the places where the incisions are to commence and terminate; these being the tip of the external malleolus and the point exactly opposite on the inner side, *i. e.*, not at the tip of the internal malleolus, but considerably below and behind it. With a knife, short and strong both in blade and handle, he now cuts down to the bone across the sole, from one of these points to the other, in a plane either vertical or sloping slightly towards the heel when that part is unusually prominent; and then, extending the foot, joins the horns of this incision by another running as straight as possible across the front of the ankle. He next dissects up the posterior flap from the os calcis, keeping the edge of the knife close to the bone with the guidance of the left thumb-nail, till the point of the calcaneum is fairly turned, when he proceeds to open the joint in front, divides each lateral ligament with a stroke of the knife applied between the malleolus and astragalus, and completes the removal of the foot by severing the tendo Achillis. He then prepares the bones of the leg for the application of the saw; taking care, when cutting behind the tibia, to keep close to its surface, from which the posterior tibial artery is separated only by a little loose cellular tissue; and lastly, he takes off the malleoli along with a slice of the intervening part of the tibia, sawing perpendicularly to the axis of the limb.

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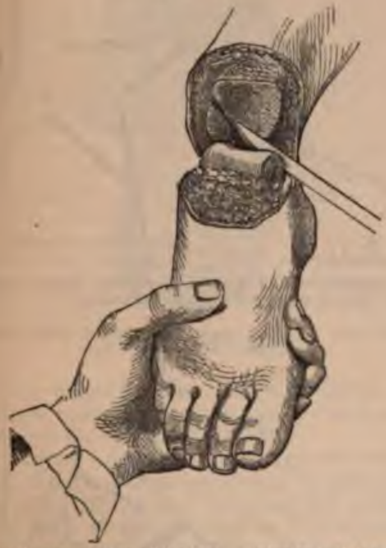
[1] Surgical Lectures, edited by Tyrrell, vol. ii., p. 432.

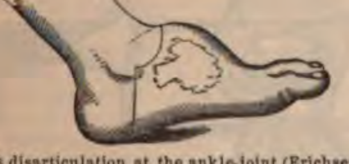
[[1] Trans. Ohio State Medical Society, 1874.]

[Fig. 810.



Syme's amputation of the foot. Anterior incision and disarticulation (Erichsen).

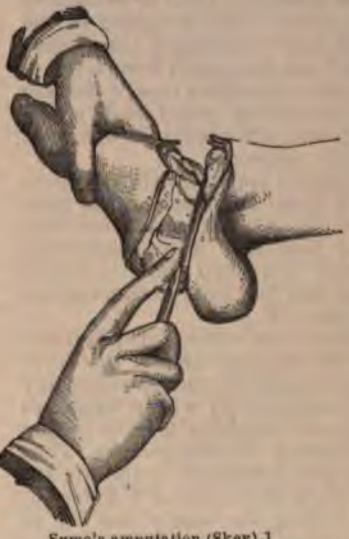
Fig. 811.



Syme's disarticulation at the ankle-joint (Erichsen).]

It is a common mistake to make the inner end of the incision at the internal malleolus, instead of opposite the extremity of the outer one. This has two bad effects: it renders the flap unsymmetrical, and, what is far worse, it makes it unnecessarily long, and thus introduces an element of difficulty and risk into an easy and safe operation. For when the incision is carried forwards to the hollow of the foot, it becomes a most troublesome task to turn back the integument over the prominence of the heel; and the knife being thrust the operator knows not where, the subcutaneous tissue on which the skin depends for its nourishment is punctured and scored, and perhaps the point of the instrument appears occasionally through the skin itself, while the flap is subjected to violent wrenching in the effort to draw it back over the bony projection. Under such a combination of unfavorable circumstances, it is but natural that it should slough.

[Fig. 812.



Syme's amputation (Skey).]

On the other hand, when the flap has been made as above directed, in accordance with the latest recommendations of the author of the operation,[1] it applies itself with perfect uniformity to the surface it is designed to cover, and has no disposition to shift to one side in the after progress of the case; and every stroke of the knife by which it is raised being made under the eye of the surgeon, without any forcible traction, it is as little liable to slough as any other portion of integument with an equally broad base and an equally rich vascular supply. Even the integrity of the posterior tibial artery, though desirable, is by no means essential, provided the rest of the subcutaneous tissue has been left uninjured. Many persons, in discussing the merits of this operation, seem to assume as an axiom that sloughing of the flap must occasionally take place; but I am persuaded from very extensive experience that, if the skin of the heel be sound, such an occurrence will always be the fault of the surgeon.

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[1] See Mr. Syme's Clinical Lectures in the Lancet, 1854.

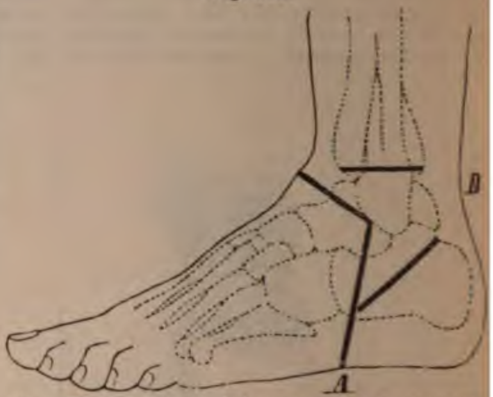
[Before approximating the flaps in a Syme amputation, it is good practice to puncture the heel-flap and introduce a drainage-tube, which will keep the cup-shaped heel-flap free from accumulations of pus.—H.]

Hence the various modifications of the original method that have been suggested, though commonly discussed chiefly with reference to a fear of sloughing, must be judged of entirely on other grounds. Thus the plan introduced by the late Dr. Richard Mackenzie, of Edinburgh, of making the base of the flap at the inner side, that it may have a more free supply of blood from the posterior tibial artery, is not to be regarded as a substitute for the simpler method of a posterior flap; yet it proves useful in case of unsoundness of the integument on the outer side of the heel; and it is probable that an external flap might be made with equal advantage if the internal aspect of the limb were affected.

The operation of Prof. Pirogoff, of St. Petersburg (figs. 813, 814), in which the posterior part of the os calcis is sawn off and turned up as part of the flap to unite with the cut end of the tibia, has the disadvantages in cases of caries that it entails a a risk of recurrence of disease in the portion of the calcaneum remaining. It is also more complicated than Mr. Syme's method, from the necessity of accurate adjustment of the osseous surfaces, with a view to their union; while the increased length of the stump which it produces is rather objectionable than otherwise; for, with the original operation, the space afforded for the artificial foot is not more than the maker finds convenient.

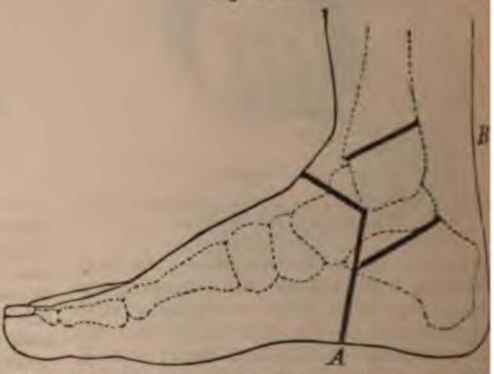
[It may be stated in regard to Pirogoff's operation that it is apt to be either a brilliant success, as shown in fig. 816, or a

Fig. 813.



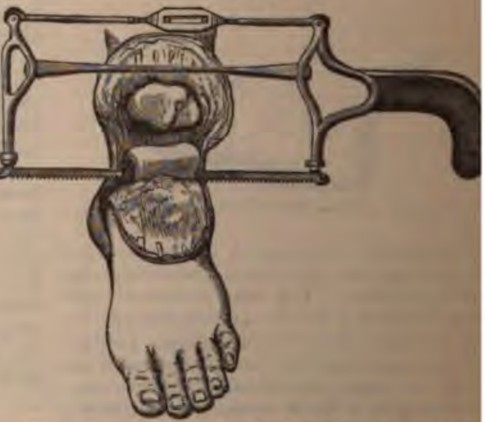
Pirogoff's amputation. *A*. Cutaneous incision (outer sid
B. Line of section of the bones (Stimson).

Fig. 814.



Pirogoff's amputation. *A*. Cutaneous incision (inner si
B. Parallel section of the bones. (Sédillot's modificati
(Stimson.)

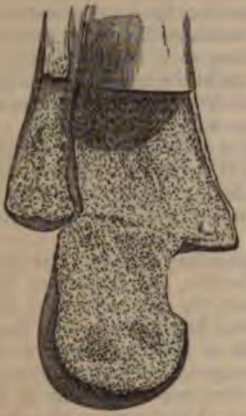
Fig. 815.



Pirogoff's amputation. Application of saw to os calcis (Erichsen).

very bad failure, the sawn bony surfaces not uniting, but becoming necrosed, the flap breaking down, and an amputation higher up being ultimately necessary.

Fig. 816.



Bony union between calcaneum and tibia after Pirogoff's amputation (Hewson).

Hence there is room for the exercise of judgment in regard to the cases which are suitable for its adoption.—P.]

[Several years ago, Prof. Agnew[1] modified the Pirogoff amputation by preserving the malleoli and inserting the posterior part of the os calcis in the mortise between them. The union of the bones will be hastened by scoring or shaving off the cartilaginous investment of the lower extremities of the tibia and fibula. When the calcaneum is placed in the intermalleolar socket the bones are more easily kept in contact with one another than is possible with the malleoli sawn off; hence union of the bones will take place sooner in the former operation than in the latter. Occasionally, however, the os calcis will be found too large for the intermalleolar space, in which event the original operation of course must be performed.—H.]

When the ankle is affected with caries, the vertical articular surfaces by which the joint is continued upwards between the tibia and fibula should be removed with cutting pliers, to guard against recurrence of disease in that situation.

In cases which do not admit of Mr. Syme's operation, amputation immediately above the ankle should be performed if possible, in preference to that at "the seat of election," a little below the knee; for although the use of the knee-joint may be retained even with a very short stump, the longer one gives greater command over the artificial limb, and the operation involves less risk to life.

Different methods may here be employed. One mode is to make a short semilunar anterior flap cut from without inwards, and a larger posterior one formed by transfixing behind the bones and cutting downwards and outwards, the saw being applied a little above the bases of the flaps; or antero-posterior skin-flaps of equal length may be made, and the bones divided somewhat higher up. Or again, the modified circular operation[1] is applicable in this situation.

But the method by longer anterior flap is greatly to be preferred to any other, on account of the excellent covering it affords, with the cicatrix out of the way of pressure, enabling the stump to sustain the whole or a considerable part of the weight of the body on its extremity. The principles on which the operation should be performed have been already fully discussed in former pages,[2] but a modification of the plan there indicated is called for on account of the difficulty of retracting the soft parts from the bones. This arises especially from the intimate attachment of the muscles to the fibula; but if these are divided through an extension upwards of the outer longitudinal incision, no difficulty is experienced, unless the tissues are condensed by inflammatory thickening, in effecting retraction of the remaining soft parts from the tibia without dividing the skin at the inner side to a higher level than the typical operation demands. Another point requiring special attention in the leg, as compared with the thigh, is the raising of the anterior flap. The anterior tibial artery, on which the flap depends for its nutrition, lies close to the interosseous membrane, and would be very liable to be punctured during the dissection if we did not follow Mr. Teale's advice in conducting it. He pointed out that in consequence of the looseness of the cellular connections of the interosseous membrane, there is no difficulty in separating the parts in front from its surface with the finger tip, while dividing with the knife the attachments of the muscles to the bones.[3] In this way, the vessel is secured from any chance of injury.

Immediately above the ankle the operation is performed as follows. The diameter of the limb having been ascertained by spanning it, a straight longitudinal incision of that length is made at the inner side of the leg, and on the outer aspect another similar incision directly over the fibula and extending about an inch higher up. The lower ends of these

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[[1] Agnew's Surgery, vol. ii., p. 361.—H.]

[1] See p. 565.

[2] See p. 566 et seq.

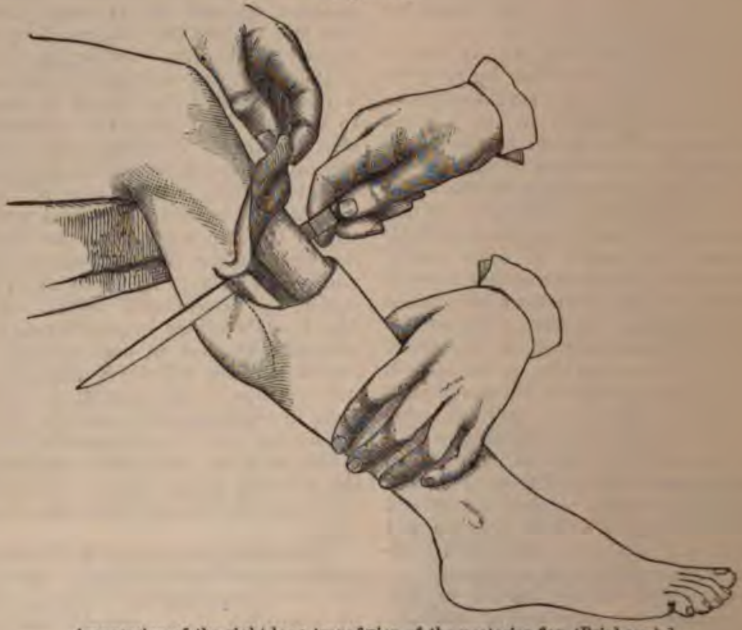
[3] See Medical Times and Gazette, July 6, 1861.

incisions are connected by cutting across the front of the limb in a direction transverse in the main, but rounded off where it joins the lateral lines. The knife is next carried round the back of the limb to the bones from the upper end of the internal incision to a point exactly opposite on the outer side, which will be about an inch below the upper end of that incision; the instrument being carried in a line slightly convex downwards, so as to form a very short posterior flap. The anterior flap is then raised in the manner above mentioned, including everything in front of the bones and interosseous membrane; after which the tibia and fibula are cleared as high as the level of the upper end of the outer incision, the finger tip being still used in detaching the parts anterior to the interosseous membrane.

In order to avoid splintering the fibula, it is best to saw both bones at the same time, and to finish the fibula before the tibia. The sharp angle of the spine of the tibia, being apt to cause ulceration of the skin over it, should be removed; and the most convenient way of doing this is to commence with sawing obliquely for a short distance from a point about half an inch above the place where the bones are to be divided transversely. Supposing the antiseptic treatment employed, the cutaneous margins of the flaps may be stitched very closely, except at the upper end of the outer incision, which is left open for the drain, and serves admirably for the purpose, as it leads directly from the cut surfaces of the bones, and is dependent in position from the circumstance that the limb reposes on its outer side. Accurate stitching is desirable elsewhere, in consequence of the disproportion of the sizes of the two flaps, which, however, is diminished by making a short posterior flap as advised.

In amputating through the calf on the same principle, the operation is similar, except that, for reasons before discussed,[1] the anterior flap need not be longer than two-thirds of the diameter of the limb; but, to compensate for its diminution, the posterior flap must be made at least half as long as the anterior, by carrying the knife round the back of the limb at an angle of forty-five degrees through the integuments, and dissecting them up to the level of the upper end of the inner incision, before cutting towards the bones, so as to get rid of the heavy and contractile mass of the sural muscles.

[Fig. 817.



Amputation of the right leg; transfixion of the posterior flap (Erichsen).]

The old flap operation is still employed in the calf by many surgeons, being very readily accomplished by drawing the knife in a segment of a circle across the front of the leg from one bone to the other, transfixing behind them, and cutting first downwards and then gradually outwards; next dissecting up the anterior flap of integument, and clearing and dividing the bones at the level of its base. [Fig. 817.]

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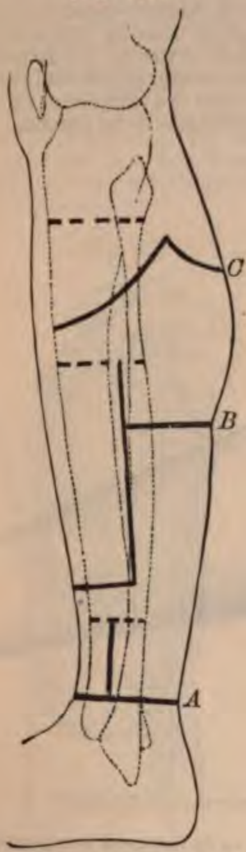
[1] See p. 569.

But it is, as we have seen,[1] a most undesirable proceeding, on account of the bulk of the muscular mass from the calf turned up to cover the ends of the bones. Professor Spence, of Edinburgh, gets rid of this objection by shaving off a considerable portion from the face of the posterior flap after forming it. But though this is undoubtedly a great improvement, it cannot give to the operation the advantages of the method by longer anterior flap.

When there is not enough sound integument to admit of the latter method, the modified circular operation of Mr. Syme[2] proves highly valuable, enabling us to form out of the smallest amount of materials a short stump, which is preferable to any that result from operating higher up in the limb, the patient either retaining the use of the joint or resting his weight with great security and comfort upon the bent knee.

[Fig. 818.



Amputation of leg. A, modification of circular; B, rectangular flaps (Teale); C, antero-posterior flaps, upper third (Bell). (After Stimson.)]

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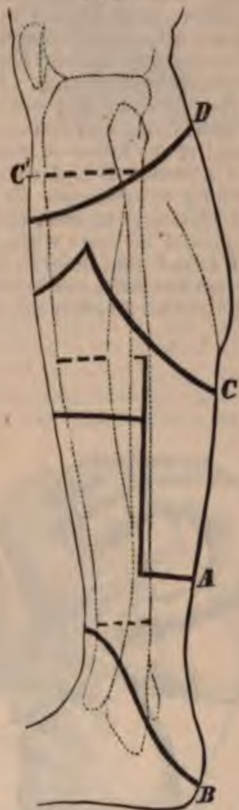
[1] See p. 564.

[2] See p. 565.

For restraining hemorrhage during amputation of the leg, the tourniquet should be applied round a roller placed between the hamstrings [or at the upper part of the thigh].

[Fig. 818 represents the incisions in several forms of amputation in the leg. At C the anterior incision should reach the outline of the limb. Other lines of division of the skin at various points are shown in Fig. 819.]

[Fig. 819.



Amputations of the leg and at the knee. A, long posterior rectangular flap (Lee); B, supra-malleolar (Guyon); C, at the upper third (Sédillot); D, disarticulation at the knee, oval incision (Stimson).]

The great merits of Mr. Carden's amputation through the condyles of the femur have been already fully discussed.[1] I cannot but agree with him that the patella should always be removed. In cases of injury it may seem a tempting thing to leave it, sawing off its articular surface, that it may unite with the divided end of the femur; but having tried this plan before Mr. Carden published, I have found that while it may result in an admirable stump, it is sometimes attended with serious inconvenience, from the patella being tilted up from its proper position by the action of the quadriceps extensor. Besides this, the presence of the patella in the covering for the end of the femur interferes with its adequacy, and makes it needful to borrow more integument from the front of the leg than is otherwise requisite. And as regards the ultimate result, when the sawn extremity of the femur has been rounded off by ossific deposit, it proves little, if at all, inferior to the patella for bearing the weight of the body. The only objection to Carden's operation, as described by him,[1] is the occasional occurrence of more or less sloughing of the long anterior flap of skin, in spite of faultless operating. It is plain that the risk of sloughing would be diminished if the flap could be made shorter by not carrying the horns of the incision by which it is formed so high up the limb; and on making experiments on the dead body some years ago, to ascertain to what extent this could be done without disadvantage, I found that it is by no means difficult, when the parts are in their natural condition, to accomplish the operation without making any anterior flap at all, the integuments being divided transversely, as in the old circular method, at the level of the lower end of Mr. Carden's flap. I also found it advantageous to form a short posterior skin-flap, both for the sake of coaptation of the cutaneous margins without puckering, and as a useful addition to the covering for the end of the stump.

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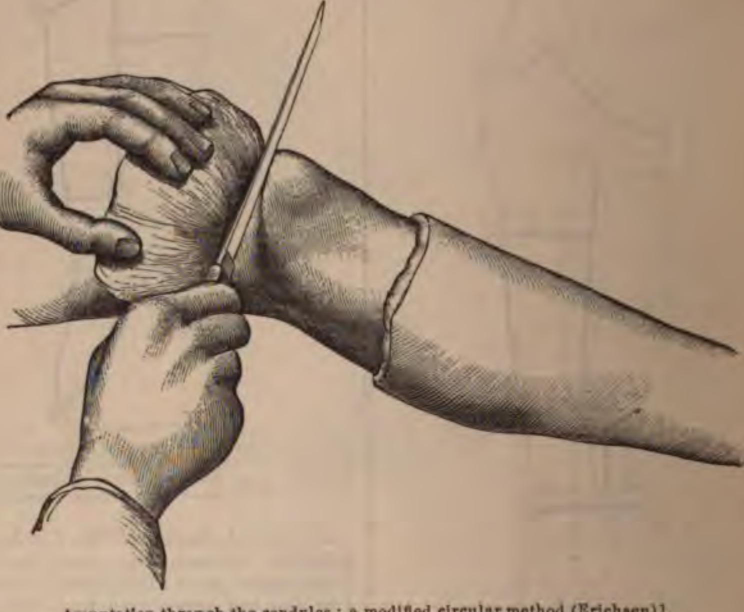
[1] See p. 568.

With this modification, the operation is performed as follows: The surgeon first cuts transversely across the front of the limb from side to side at the level of the anterior tuberosity of the tibia, and joins the horns of this incision posteriorly by carrying the knife at an angle of forty-five degrees to the axis of the leg through the skin and fat. The limb being elevated, he dissects up the posterior skin-flap, and then proceeds to raise the ring of integument as in a circular operation, taking due care to avoid scoring the subcutaneous tissue; and, dividing the hamstrings as soon as they are exposed, and bending the knee, he finds no difficulty in exposing the upper border of the patella. He then sinks his knife through the insertion of the quadriceps extensor [Fig. 820], and having cleared the bone immediately above the articular cartilage and holding the limb horizontal, he applies the saw vertically, and at the same time transversely to the axis of the limb (not of the bone), so as to insure a horizontal surface for the patient to rest on. The popliteal artery is then secured, and any articular or other small branches that may require it.

[Fig. 820.



Amputation through the condyles; a modified circular method (Erichsen)].

When the soft parts are thickened and condensed by inflammation, the integuments cannot well be reflected above the patella with such incisions of the skin

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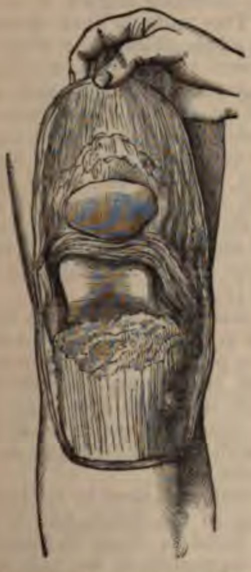
[1] See p. 568.

But the difficulty may be got over by cutting into the joint as soon as the ligamentum patellæ is exposed, and at once removing the leg by dividing the ligaments and hamstrings; after which the soft parts can be retracted from the femur sufficiently to permit the application of the saw. The arteries having then been secured, the patella is dissected out at leisure.

As thus performed, Carden's operation takes a little more time and pains than when the integument is divided in the form of an anterior flap; but these are well rewarded by the ample covering for the bone, the small external wound, and the perfect security against sloughing.

[Gritti's operation is a modification of Carden's, on the same principle as that of Pirogoff, before described: he saws off the end of the femur and the cartilaginous face of the patella, and brings together the cancellous surfaces of bone thus exposed. The lines of incision of the skin are shown at A, and those of section of the bones at A^1, fig. 826, p. 604. Gritti's operation has not been, to my knowledge, received with favor by American surgeons.—P.]

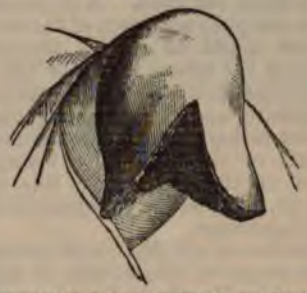
[Fig. 821.



Long anterior flap at the knee (Erichsen).]

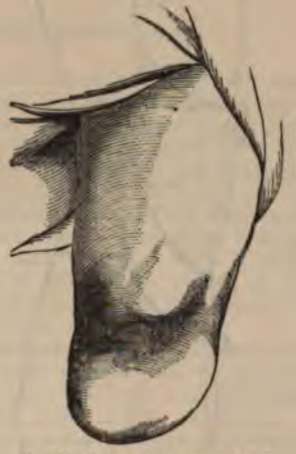
Some surgeons speak highly of amputation through the knee, leaving the articular portion of the femur and patella, a covering being provided by forming a large anterior and short posterior skin flap from the leg [fig. 821], the result being that the patient rests his weight upon the broad rounded end of the bone, while the patella is drawn up by the quadriceps to occupy the hollow between the condyles in front.[1] There can hardly, I think, be two opinions as to the superiority of Carden's method to this procedure for carious disease of the knee-joint, and in cases of injury, when the integuments are sound as far as five inches below the patella, which is the length of the long anterior flap according to the method hitherto recommended,[2] a satisfactory though very short stump may be made below the knee. But from my experience with Carden's operation I feel sure that the amputation through the knee may be much improved by dividing the integument in the circular fashion, slightly modified to permit neat adjustment of the cutaneous margins, in which case it would not only be freed from the risk of partial sloughing of the

[Fig. 822.



Amputation at knee by two lateral flaps.]

[Fig. 823.



Result of the above operation.]

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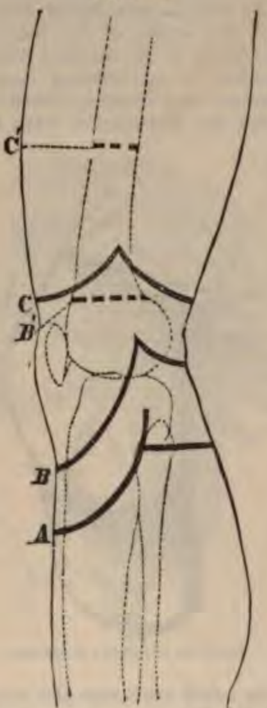
[1] See especially a paper on amputation at the knee-joint, by Mr. Pollock, Medico-Chirurgical Transactions, 1870.

[2] See Mr. Pollock, ibidem.

anterior flap which is admitted by its advocates,[1] but, the posterior integument being made to take a larger share in forming the covering, it would not be needful to go so far down the limb in front, and thus the operation would become available for cases of injury reaching too high in the limb to permit amputation below the knee. And in order to ensure complete adequacy of the covering, the saw might be carried through the middle of the articular end of the femur so as to flatten it without interfering with its breadth, and thus in all probability improve rather than impair the fitness of the end of the stump for bearing the weight of the body. On this matter, however, I cannot as yet speak from personal experience.

[The reader will find much information on the subject of amputation at the knee in two valuable papers by American surgeons: one by Dr. Markoe, of New York, in the New York Medical Journal for March, 1868; the other by Dr. Brinton, of Philadelphia, in the American Journal of the Medical Sciences, for April of the same year. The lines of incision of the skin in the ordinary disarticulation at the knee are shown in the diagram, fig. 824, at A. At B, in the same figure, is shown the line of division of the skin, and at B' that of the bone, in Carden's supra-condyloid amputation.—P.]

Fig. 824.



Amputation at the knee and lower third of the thigh. A, disarticulation, long anterior flap; B, amputation through the condyles (Carden). C, modified flap amputation at the lower third of the thigh (Syme). (Stimson.)

In amputation of the thigh, if we except cases in which the soft parts are affected at one side only, where a covering may be advantageously provided from the sound side, the flaps should always be antero-posterior, because, the flexor muscles being no longer counteracted by the weight of the limb, the bone tends to become tilted forwards, so that its extremity would be apt to show itself in the anterior angle of the lateral flap.

In the lower half of the thigh, the method by longer anterior flap, on the principles before considered,[1] will be found easy of execution and excellent in results. Two straight incisions are made through the skin and fat along the lateral aspects of the limb, parallel to its anterior surface, and equal in length to two-thirds of its diameter, and their inferior extremities are connected in front by a straight transverse cut, curved upwards near its ends to join the longitudinal ones, so as to shape out a moderately long rectangular flap with rounded angles, if we may so speak. The knife is then passed round the back of the thigh at an angle of forty-five degrees to its axis, marking out a short posterior skin-flap, which is at once dissected up, the limb being well elevated by an assistant. The anterior flap is next raised so as to contain a moderate amount of muscle, and the soft parts being well retracted, the knife is swept circularly through the muscles, so as to expose the bone for the application of the saw about two inches above the angle of union of the flaps [fig. 825].

The incisions should always be made as far down in the limb as the state of the soft parts permits, so as to increase the length of the stump and diminish the danger of the operation; and the skin over the patella, if available, will be employed with great advantage as part of the anterior flap.

The tourniquet must be applied as high as possible in the thigh, and if the constricting band is found to interfere with the due retraction of the soft parts, it is best to saw the bone in the first instance where it is easily reached, and after securing the vessels and removing the tourniquet, expose the bone at the requisite level, and saw off an additional portion, held steady with a pair of strong forceps. In this way the great benefits of the tour-

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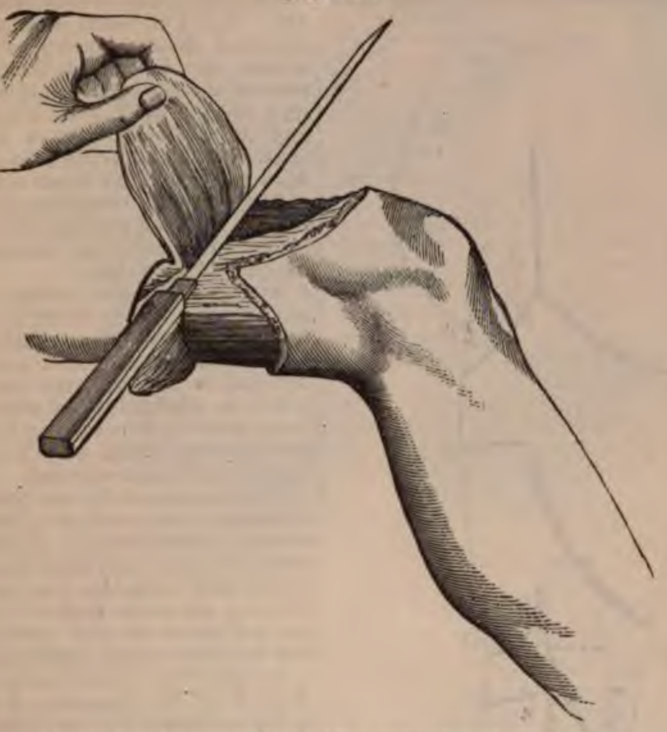
[1] See Mr. Pollock, ibidem.

[1] See p. 569.

[Fig. 825.



Amputation of the thigh; flaps cut from without inwards (Erichsen).]

niquet, in rendering the operation almost bloodless, may be secured for amputations at a level in the limb at which it would otherwise be inadmissible.

When digital compression is resorted to, the hands should grasp as much of the circumference of the limb as possible, while the thumb is placed over the vessel, as it lies on the pelvis, midway between the symphysis pubis and the iliac spine.

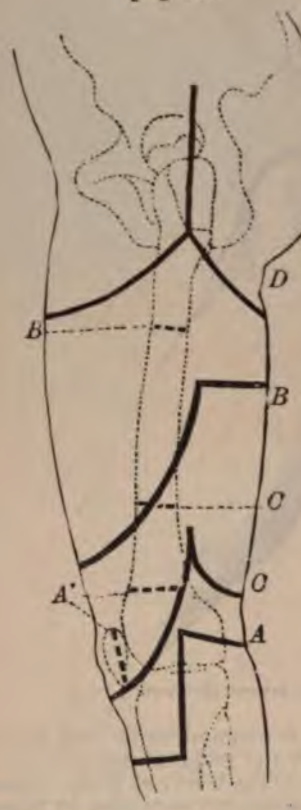
Even in the upper part of the thigh, although the object of having a stump capable of bearing weight upon its extremity is no longer to be considered, the operation above described will be found to yield better results than that by transfixion, by avoiding the redundancy of muscle which is the great defect of the latter method. Nor need this plan involve greater loss of blood. For the posterior flap, being only cutaneous, can be raised without material bleeding; and the anterior flap, after being shaped by carrying the knife through the skin and fat, may be completed by transfixion, while comparatively little retraction of the soft parts is required, in consequence of the shortcut muscles having little tendency to cause protrusion of the bone.

[Fig. 826 exhibits, at *A*, the operation of Gritti at the knee, before described (p. 601); at *B* amputation by long anterior flap above the middle, *b* being the point of section of the bone; at *C* the amputation low down, recommended by Spence, of Edinburgh; and at *D* one (oval) method of disarticulation of the hip.]

Amputation at the hip-joint, though a most formidable proceeding, has, nevertheless, been attended with a sufficient amount of success to render it justifiable in circumstances that would otherwise be desperate.

The easiest and most rapid method is to form a large anterior flap by transfixion, disarticulate, and cut a short posterior flap, also from within outwards. The thigh being somewhat flexed, to relax the soft parts of the front of the limb, the point of a knife with a blade about a foot long is entered midway between the anterior superior spinous process of the ilium and the great trochanter, supposing the left side operated on [fig. 827], and passed in front of the bone till it emerges near the tuberosity of the ischium, or in the opposite direction if it be the right limb. The knife is then carried longitudinally with a rapid sawing movement, followed by the fingers of one hand of an assistant, which are introduced into the wound so as to compress the femoral artery securely between them and the thumb, previously placed over it in the groin, his other hand being employed to lift up the large anterior flap as soon as it is completed. [Fig. 828.] The limb being now extended and abducted, the surgeon opens the capsule of the joint by cutting firmly upon the head of the bone; and as this starts from its socket, he divides the round ligament and the posterior part of the capsule; lastly, the thigh having been adducted, to draw the trochanter down out of the way of the knife, he completes the severance of the limb by cutting downward and backward through the muscular mass at the back of the thigh.

[Fig. 826.



A, Gritti's amputation at knee. *A'*, lines of division of the bone. *B*, Long anterior flap (Sedillot). *B'*, Division of bone. *C*. Amputation at lower third (Spence). *C'*, Division of the bone. *D*. Disarticulation at the hip (Stimson).]

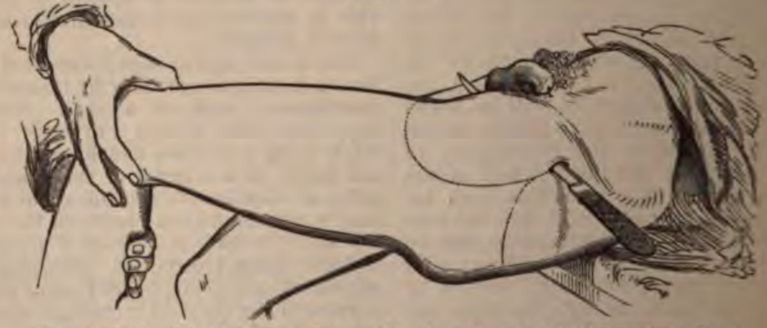
Attention is now at once directed to the bleeding vessels of the posterior flap, fed by the internal iliac, which are covered in the first instance with a folded cloth, or, what is better, by the tips of the fingers of an assistant; and when they have been tied, the femoral trunk and any of its branches which may require it are secured in the anterior flap.

[Dr. Morton, of Philadelphia, has used a method of disarticulating the hip by first making a longitudinal incision on the outer side, then dividing the skin anteriorly, and securing the artery; then severing the other tissues in front, turning out the bone, and cutting the posterior flap from within outwards.

A somewhat similar method has been devised by Mr. Furneaux Jordan, who, however, makes first the lengthwise incision; then turns out the bone, and divides the soft parts of the thigh at any desirable point.[1]—P.]

When the state of the parts does not admit of a long anterior flap, the posterior one may be lengthened without increasing the hemorrhage, by shaping it at the commencement of the operation by an incision extending only through the skin and fat, and dissecting up the integument to the part where the muscles can be conveniently divided from within outward, after the shorter anterior flap has been formed and disarticulation effected in the usual way.

[Fig 827.



Disarticulation of the hip by transfixion, with a long anterior and short posterior flap.]

But cases not unfrequently occur in which the antero-posterior method by transfixion is altogether inapplicable; and when

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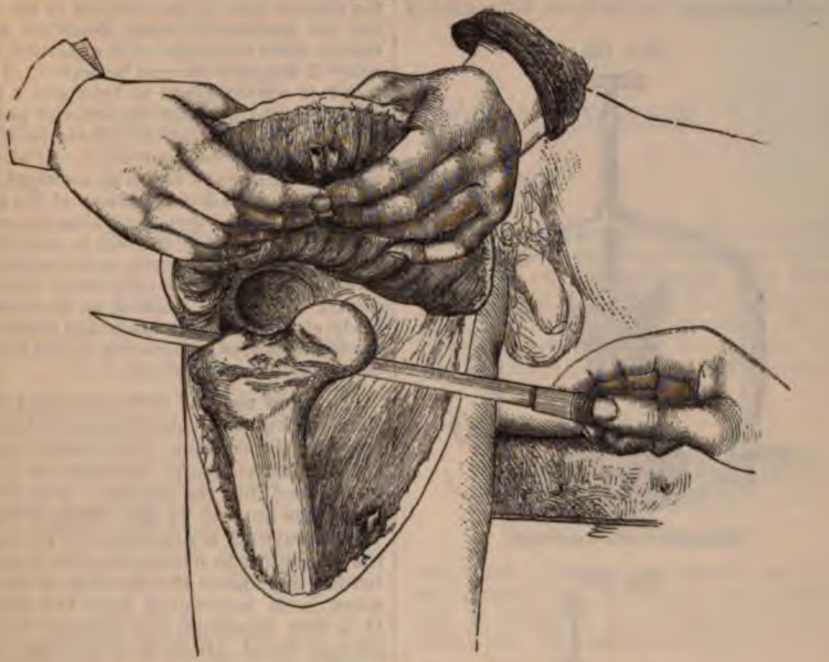
[1] Lancet, March 22, 1879, p. 405.—P.]

[Fig. 828.



Amputation at hip-joint; compression of femoral artery in anterior flap.]

affects the upper part of the bone, or when the soft parts are destroyed by injury extending high up at one side. The integuments must then be turned to account to form a covering, according to the best judgment of the surgeon, by operations necessarily more or less protracted. Under such circumstances, and, indeed in all cases of amputation at the hip-joint, great advantage will be derived from the use of the aortic tourniquet, an instrument first used for this purpose by Professor Pancoast, of Philadelphia, in 1860,[1] and since employed sufficiently often to prove alike its safety and efficiency [figs. 829, 830]. By its means, the flow of blood through all the branches of the internal as well as external iliac artery being completely arrested, amputation at the hip-joint is divested of the risk of serious hemorrhage, which used to be its most formidable danger. In the form suggested by myself, in which alone I have seen it, the instrument consists of a bar of steel bent in a nearly semicircular form, to embrace the side of the body, with one end expanded and covered with soft material for application to the back, while the other end receives a screw, which presses down a pad somewhat broader than the diameter of the aorta; the object being to compress the artery as it lies on the body of the fourth lumbar vertebra, without obstructing more than necessary the return flow through the vena cava. It is to be remembered that no great force is required to arrest the arterial current, provided the pressure be accurately applied, while mischief might be done by using the screw with needless violence. The only way to ensure accuracy of adjustment of the tourniquet is to feel for the pulsation of the aorta and screw the pad down upon the pulsating part: for the umbilicus is a most untrustworthy guide, and the vessel is by no means constantly to the left of the middle line, as described in anatomical works, but, happily for its satisfactory compression, appears to be as frequently mesial, where the body of the vertebra is practically flat, while it is occasionally found a little to the right.[1] The iliac

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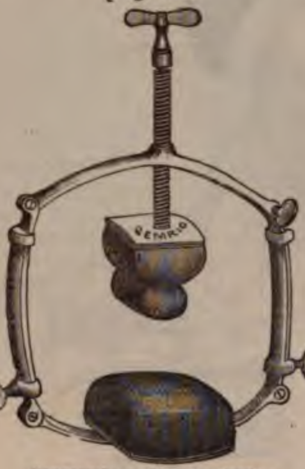
[1] See the American Journal of the Médical Sciences, July, 1866. In the former edition of this article, written in 1861, the aortic tourniquet was alluded to as if originating with myself. It was only comparatively lately that I became aware that I had been anticipated by Professor Pancoast.

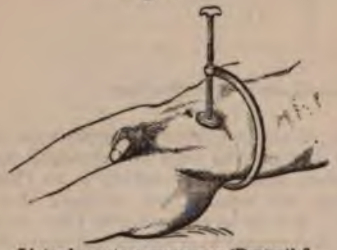
[1] Out of thirty bodies examined, seventeen by myself, and thirteen by my friend Dr. Barbour, then resident physician to one of the Glasgow workhouses, and afterwards of the London Fever Hospital, the aorta was either absolutely or almost absolutely mesial in fifteen, while in thirteen it deviated more or less to the left, and in two was slightly to the right. In order to make the observations accurately, three long needles were pushed down vertically, and therefore parallel to each other, one at each side of the body of the vertebra, and one through the centre of the collapsed aorta into the vertebra beneath. The distance of the middle needle from each

[Fig. 829.



Pancoast's aortic compressor.

Fig. 830.



Liston's aorta compressor (Bryant).]

crests are the best guide to the level at which the clamp should be fixed, the bifurcation of the aorta being nearly on a line with their highest parts, so that the instrument should be put on a little above them. When the centre of the aorta is as much as half an inch to the left of the middle line, which is a rare occurrence, the screw of the tourniquet comes to deviate laterally from the vertical direction, as the patient lies, by an angle of about thirteen degrees, in order to be perpendicular to the convex body of the vertebra at the part; but the instrument above described can be readily made to assume such a position, especially if the posterior pad be convex. I have found it advantageous to interpose a small round sponge between the anterior pad and the abdomen, as it accommodates itself well to the parts to be compressed. While the pad is being screwed down, an assistant, with his finger on the femoral artery at the groin, marks the time when the pulsation ceases. Since it is impossible entirely to avoid interference with the vena cava, with a consequent tendency to venous engorgement, the limb should always be emptied of its blood by freely elevating it and bandaging firmly from the toes upwards immediately before the performance of the operation.

[Another method of controlling hemorrhage in hip-joint amputation is by compressing the common iliac artery against the lumbar vertebræ by means of a lever introduced into the rectum. This instrument was devised by Mr. Richard Davy.[1] The rectal end is graduated to inches, so that the surgeon who applies the lever can readily determine the position of the end when it is introduced into the rectum. It is thus described :[2] a straight cylinder of hard wood, about two feet long, most carefully turned and smoothed. Its circumference is two inches, but at each end it is enlarged for a distance of three or four inches to a circumference of two and three-fourths inches.

Previous to its use the rectum must be emptied, and should be free from stricture and ulceration. The lever having been carefully lubricated is passed up the rectum towards the sacral promontory, and then the handle is inclined to the sound side until the pulsation in the femoral artery ceases ; it is then steadied by being grasped along the inside of the sound thigh.[3]—P.]

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of the lateral ones was read off on a measure applied transversely, half the difference giving the deviation of the artery from the middle line.

[[1] Brit. Med. Journ., Nov. 1, 1879, p. 685.]

[[2] Trans. of Clinical Society of London, vol. xii., p. 173.]

[[3] See also Davy's Surgical Lectures, p. 74, London, 1880.—P.]

[OPERATIONS UPON THE ARTERIES.

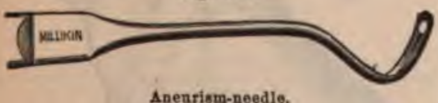
By John H. Packard, M.D.

Ligations.

Although this subject has been discussed at length in the essay on Diseases of the Arteries, in Vol. II., it has been thought advisable to give, under the head of Operative Surgery, a concise résumé of the procedures for securing the principal arteries in their continuity. There is no class of operations in which success depends more upon the accurate anatomical knowledge and the manipulative skill possessed by the surgeon, than in those now to be considered. Many of these cases, moreover, demand the utmost nerve on the part of those undertaking them.

When an artery is to be tied in its continuity, it is important to select a portion of it where no branches are given off, and completely to isolate it, in the following way: An incision is made through the skin and fascia, from one to four or five inches long, according to the size and depth of the vessel, somewhat across the course of the latter; the successive layers of tissue are then divided to an equal extent, either by cutting upon a grooved director, or by tearing, until the fibrous sheath of the artery is exposed; this is then pinched up with a pair of forceps, near the middle of the exposed portion, and nicked sufficiently to allow of the insertion of a director within it, so that it may be laid open lengthwise for a short distance, a quarter to half an inch, and the artery distinctly seen, felt, and isolated.[1] For passing the ligature, the instrument generally used is the aneurism needle, or if this is not at hand, an eyed probe may be bent into the same shape. It may be passed first, the ligature put through the eye, and the needle withdrawn.

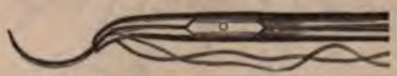
Fig. 831.



Aneurism-needle.

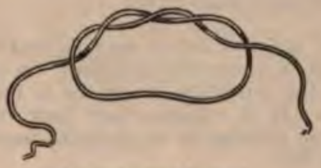
A much more convenient instrument is a small, sharply-curved, blunt needle, roughened at the end opposite to the eye. This, threaded, can be grasped in a pair of forceps, at any desired angle, and fairly passed under the artery; then detaching the forceps, and seizing the other end, it is drawn out, bringing the ligature into place. This is simply "Physick's needle," but blunt. The surgeon should now satisfy himself that the artery and nothing else is included in the ligature, which should be tied in a square reef-knot (fig. 789, p. 583), or in a surgeon's knot (fig. 833), and the wound closed, leaving one or both ends of the ligature hanging out.

Fig. 832.



Physick's artery forceps (Gross).

Fig. 833.



Surgeon's knot (Gross).

In fig. 834, the incision is shown as made *parallel* to the course of the artery; at *A*, the mode of nicking the sheath; at *B*, the passing of the needle, and the thread introduced into the eye; at *C*, may be seen the best mode of tying the ligature.

As a general rule, it is safest, when the artery has but one accompanying vein, to pass the needle in the direction *away from* the vein; that is, to enter it between the artery and the vein. In this way we run less risk of wounding or bruising the walls of the vein,—a very serious matter.

Even with the most accurate knowledge of the usual or normal anatomy of the parts, the pulsation of the artery is generally an important aid to the surgeon in finding it. But it must be remembered that anomalies are frequently met with, and care should always be taken to detect them if they exist,—before the operation,

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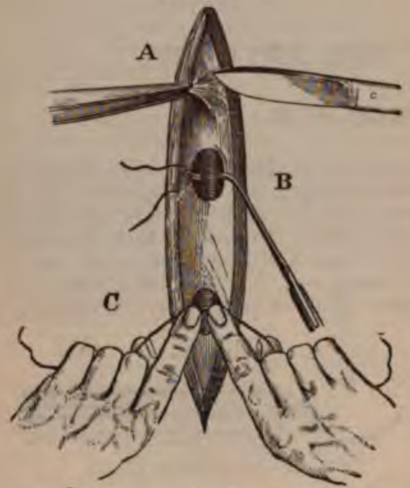
[1] For small arteries, this division of the sheath is not necessary.

Fig. 834.

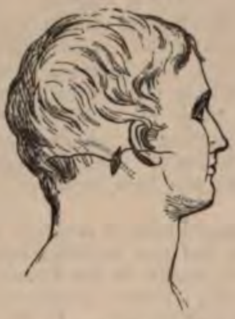


Ligation of arteries. *A*, Opening the sheath. B, Drawing the ligature around the artery. *C*, Tying artery (Bryant).

in order that it may be modified to suit the peculiarities of the case, and during the operation (as for example, when there is a high bifurcation of the brachial), lest for want of such care the whole procedure should prove ineffective.

The *occipital* artery may be tied for a wound or traumatic aneurism. In either case, the pulsation would be a reliable guide. It is exposed just back of the mastoid process by an incision made as in fig. 835.

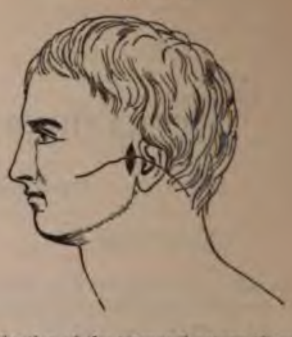
Fig. 835.



Ligation of the occipital arteries (Gross).

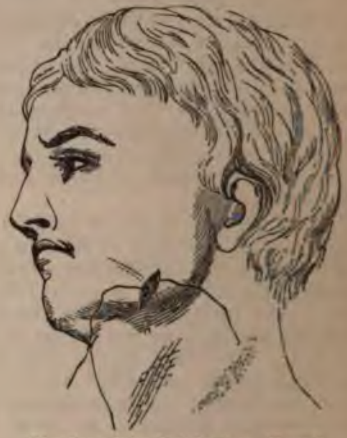
The *temporal* artery is generally controllable by pressure, but it may be desirable to tie it for traumatic aneurism; it may be reached just in front of the ear, as in fig. 836. (The incision should be made more obliquely than is represented in the cut.) Some operators prefer a transverse line, as in fig. 838, at *D*. The

Fig. 836.



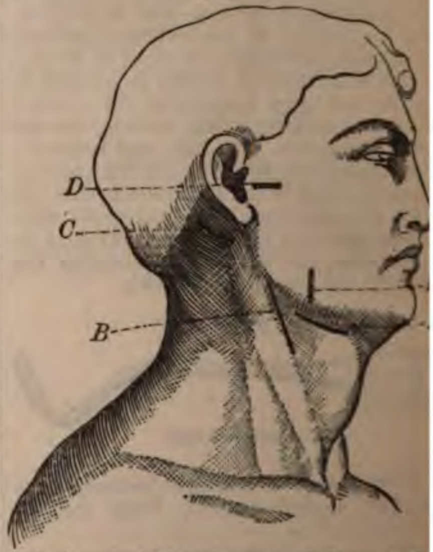
Ligation of the temporal artery (Gross).

Fig. 837.



Ligation of the facial artery (Gross).

Fig. 838.



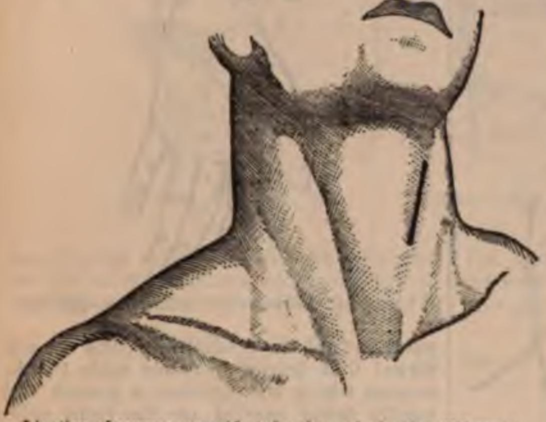
Ligation of—*A*, Lingual artery. *B*, External carotid. *C*, Occipital. *D*, Temporal. *E*, Facial (Stimson).

facial may be readily tied where it crosses the body of the lower jaw (figs. 837, 838).

The *lingual* rarely requires to be tied, but of late this has been sometimes done as a preliminary to operations on the tongue. The proper incision is shown at *A*, fig. 838. In the same figure, at *B*, may be seen the line of incision for exposing the *external carotid;* and the same would give access to the *internal carotid* (see Vol. II., pp. 430-431), or to the *superior thyroid* (*ibid.*, p. 432).

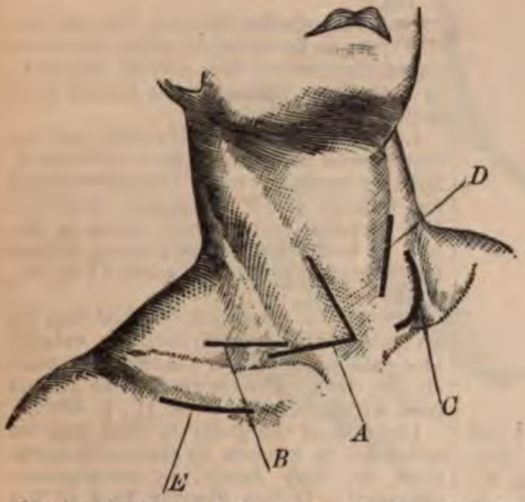
For the *common carotid*, the incision is shown in fig. 839. (See also Vol II., p. 428, and fig. 329., ibid., p. 405.)

Fig. 839.



Ligation of common carotid at the place of election (Stimson).

Fig. 840.



Ligation of arteries. *A*, Innominate. B. 2d or 3d portion of subclavian. *C*, 2d or 3d portion of subclavian (Skey). *D*, Vertebral or inferior thyroid. *E*, Axillary below the clavicle (Stimson).

Fig. 840 shows very well the different incisions employed for the ligation of vessels at the root of the neck.

At *A*, is seen the line most convenient for exposing the innominate artery. This vessel has only been once tied successfully, and then the carotid was secured at the same time, and the vertebral a month afterward; the whole case presenting a singular instance of pluck and perseverance on the part of both surgeon and patient. (See Vol. II., p. 414.)

The flap being turned up, the surgeon divides the sterno-cleido-mastoid muscle near its insertion, and dissects down until he reaches the carotid, and by following this downward the innominate artery is of course reached.

The same incisions would answer for ligation of the *subclavian in its first part*, should occasion arise justifying such an attempt.

To expose the *2d or 3d portion* of the *subclavian*, the skin may be divided in the line *B*, or *C*, fig. 840. The external jugular vein must be drawn aside inward, and the tubercle of the first rib found as the guide to the artery, which is just at its outer side. (Vol. II., p. 404).

At *D*, is seen the incision for ligating either the inferior thyroid or the vertebral. The carotid tubercle, or anterior tubercle of the transverse process of the sixth cervical vertebra, is the guide to both vessels; the vertebral lying directly below it, the inferior thyroid more outwardly. (Vol. II., pp. 415, 432.)

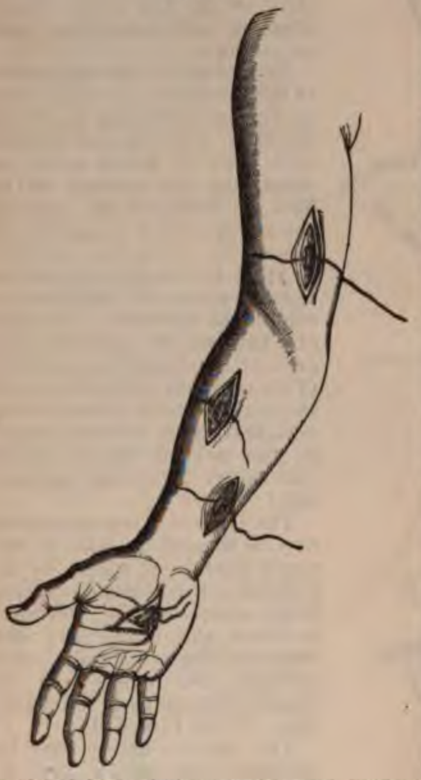
The *internal mammary* artery may be secured in either of the upper intercostal spaces by an incision carried obliquely across from close to the sternum, between the cartilages; the muscular fibres being dissected through, the vessel will be found lying on their inner surface. (Vol. I., p. 784.)

The *axillary* artery may be exposed by an incision as at *E*, fig. 840, the fibres of the pectoralis major muscle being cut through; or entirely below the muscle, the arm being drawn upwards and the axillary structures made tense. This latter procedure brings us nearer to a number of branches, and at either point the vessel is in the midst of a plexus of nerves, from among which it must be carefully isolated. (Vol. II., p. 403.)

The *brachial* artery may be tied at almost any point in its course along the inner side of the biceps muscle—generally at the middle or a little above.

The *radial* artery lies nearly in a line from the middle of the bend of the elbow to the styloid process of the radius. The *ulnar* artery lies very deep at its upper portion, and at the lower runs along close beside the tendon of the flexor carpi ulnaris. It is not very often necessary or advisable to tie either of these arteries in the continuity except for wound; as the cases which might seem to call for this would be better dealt with either by ligature of the brachial, or by taking up the vessel on both sides of the lesion (Vol. II., p. 399). Fig. 841 shows ligation of the brachial low down, of the radial and ulnar, and of the vessels in the palm. Fig. 842 shows the best way of exposing the radial and ulnar close to the wrist. In case of wound or aneurism in the palm, it is better to find the vessel, and tie it on both sides. The superficial palmar arch is formed by the ulnar. Cases of traumatic aneurism in this region are not very uncommon.

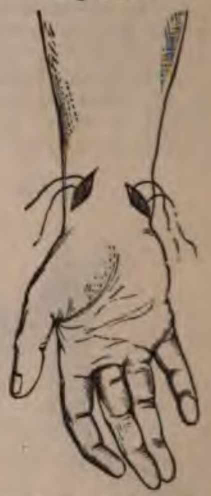
Fig. 841.



Ligation of the brachial, radial, and ulnar arteries; also of the palmar vessels (Gross).

For ligation of the *common iliac* artery, an incision is made above Poupart's ligament and parallel to it, extending beyond the anterior iliac spine—about five inches long. The muscles being divided successively, the peritoneum is pushed gently aside toward the median line, and the external iliac traced up to the main trunk, around which the ligature is placed, the needle being carried, on the right side, from without inward; on the left side, from within outward (fig. 843). (Vol. II., p. 443.)

Fig. 842.



Ligation of the radial and ulnar arteries (Pirrie).

By a very similar incision, but not carried quite so far outward, either the *internal* or the *external iliac* may be exposed; in both cases the needle is passed from within outward.

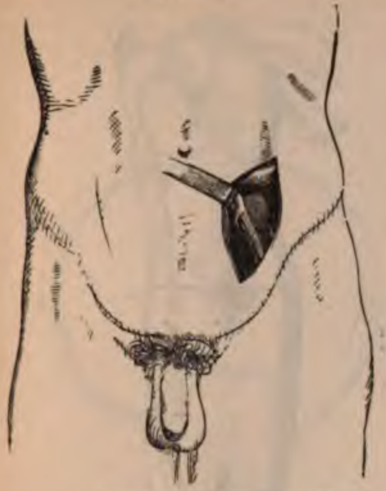
Ligation of the *gluteal*, *sciatic*, and *internal pudic* arteries has been performed, but very rarely; it may be required either for wounds or for traumatic aneurism. The incisions suitable are shown in fig. 844. *A* being that for the gluteal, *B* that for the sciatic or internal pudic (Vol. II., p. 445).

The *femoral* artery may be laid bare by an incision three or four inches in extent, along the inner side of the sartorius muscle (fig. 845). The needle is to be passed from within outward (Vol. II., p. 436).

Ligation of the *posterior tibial* may be called for by wounds, by traumatic aneurism, or, very rarely, by spontaneous aneurism. It lies directly back of the tibia, and may be reached by incisions made as in fig. 846, the deeper dissection passing through the intermuscular spaces (Vol. II., p. 433).

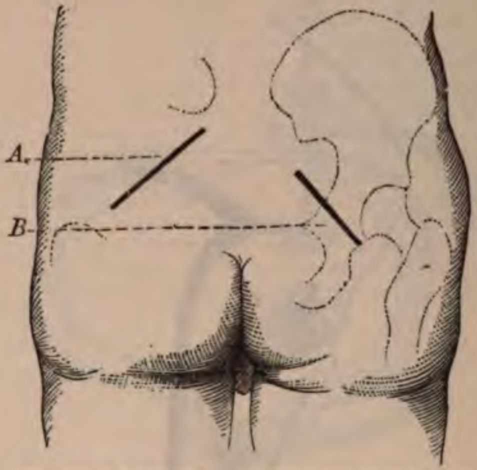
The *anterior tibial* in the upper part of its course lies deeply, and is very seldom tied. The incisions for exposing it at various points are seen in fig. 847. After

Fig. 843.



Ligation of the common iliac.

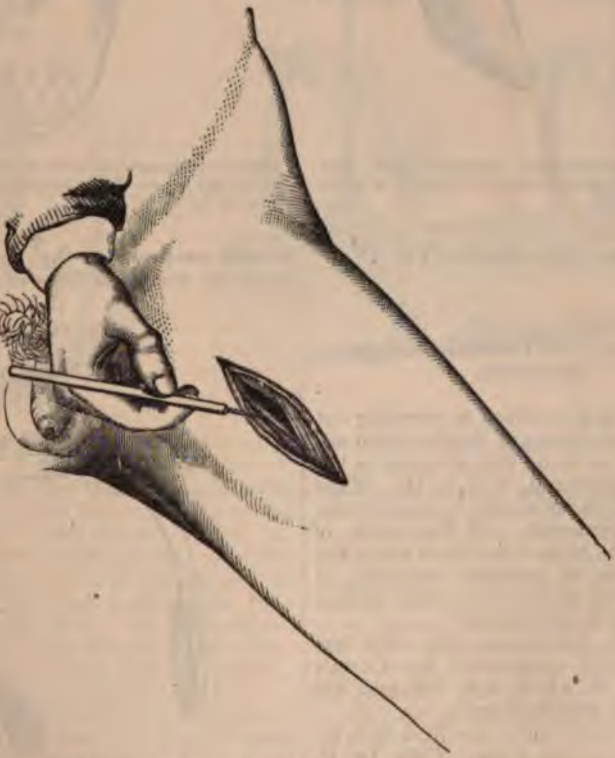
Fig. 844.



Ligation of, *A*, gluteal artery; *B*, sciatic and internal pudic (Stimson).

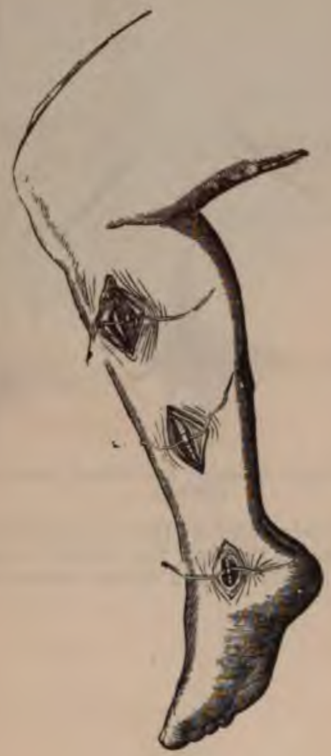
incising the skin and and superficial fascia, the intermuscular spaces are followed, and the vessel may be readily found. In the lower third of the leg, and on the dorsum of the foot, this artery is much more superficial, and can be exposed and

Fig. 845.



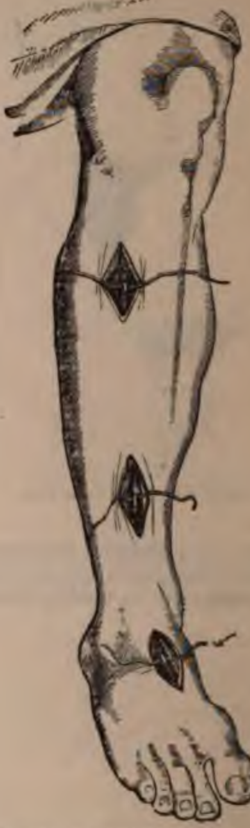
Ligation of the superficial femoral artery (Erichsen).

Fig. 846.



Ligation of posterior tibial at various points. The wounds are held asunder, and the ligature is under the vessel (Gross).

Fig. 847.



Ligation of the anterior tibial at various points. The wounds are supposed to be held asunder; the ligature is under the vessel (Gross).

tied with very little trouble (Vol. II., p. 432).

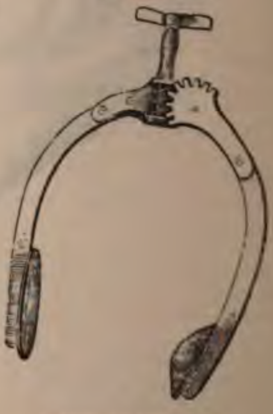
INSTRUMENTAL COMPRESSION OF ARTERIES.

The principles involved in carrying out this important means of dealing with aneurisms may be found fully detailed in the Essay on ANEURISM, in Vol. II. What will now be done is simply to present the apparatus employed, and the mode of using it. The great thing is to apply the exact amount of pressure requisite, at the right point, and in such a way as may be best borne by the patient.

Signoroni's tourniquet (fig. 848) has been generally superseded by Carte's compressor, of which figs. 849 and 850 show the two principal forms.

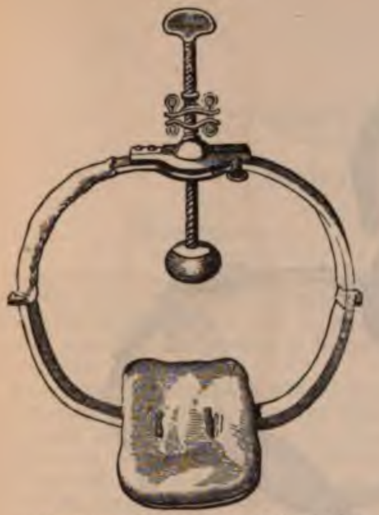
Later surgeons have modified this instrument in various ways. Thus, Dr. P. H. Watson, of Edinburgh, has used a weight-compressor, the pressure being made by means of bags of shot or sand

Fig. 848.



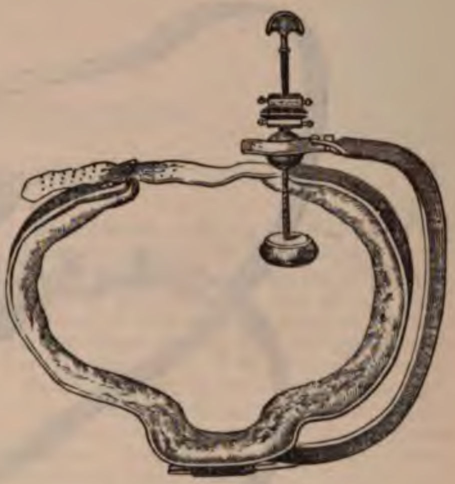
Signoroni's tourniquet.

Fig. 849.



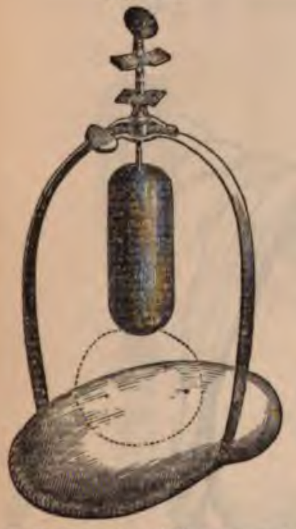
Compressor for the middle of the thigh.

Fig. 850.



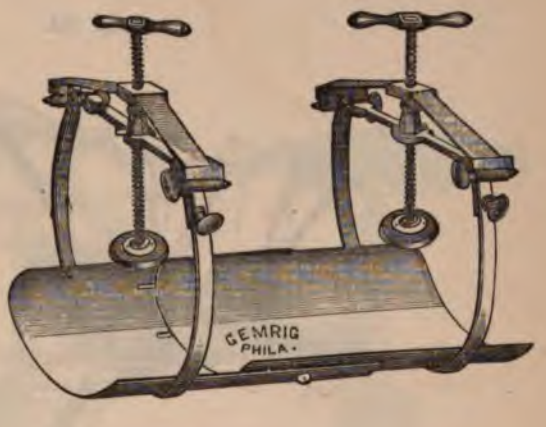
Compressor for the groin.

Fig. 851.



P. H. Watson's weight compressor.

Fig. 852.

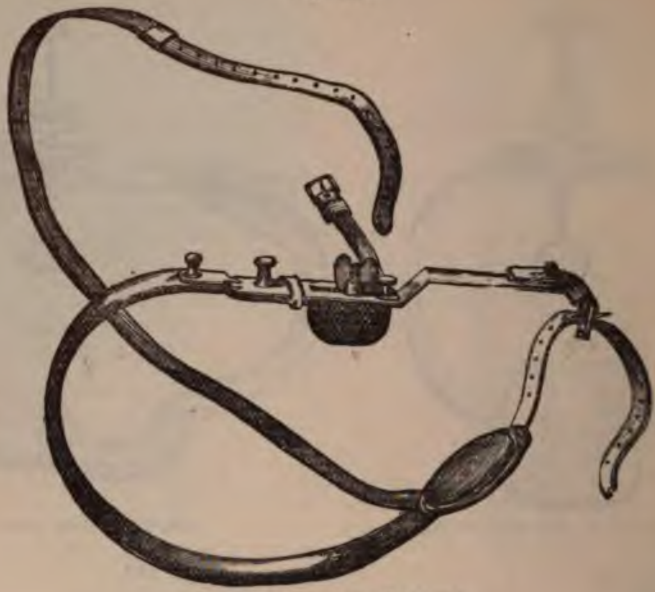


Briddon's double compressor.

suspended from the frame, as shown in fig. 851 (the dotted lines indicating the circumference of the limb). Dr. C. K. Briddon, of New York, has had a double compressor made, so as to alternate pressure at two different points, and thus prevent pain (fig. 852). Mr. Tufnell, the distinguished Dublin surgeon, uses an instrument shown in fig. 853, the application of which may be seen in fig. 854.

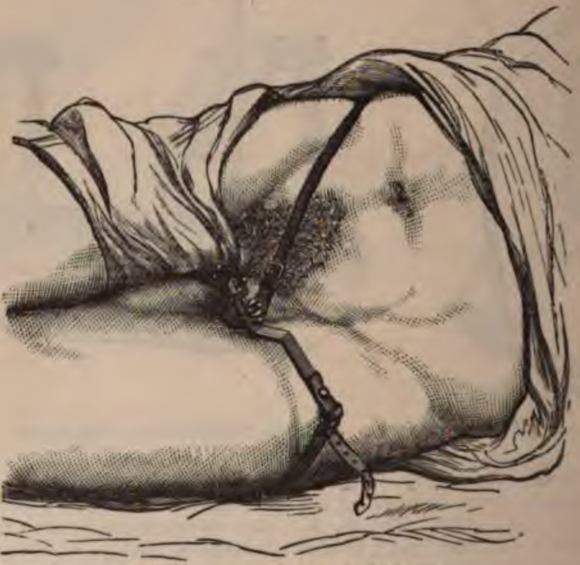
Digital compression, kept up for a sufficient length of time, by relays of competent and faithful assistants, has proved successful in very many cases, and has certain advantages over that by means of any mechanical contrivance. In some instances, patients have made manual compression themselves, with very good effect. Whatever plan is used, the object to be attained is the same: not to cut off the circulation through the aneurism entirely, but so to control it as to allow of coagulation at its periphery. Should much pain be caused, an anæsthetic may be employed.

Fig. 853.



Tufnell's compressor (Erichsen)

Fig. 854.



Tufnell's compressor applied (Erichsen).

[VARIOUS OPERATIONS.

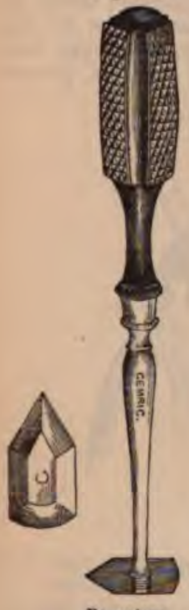
By John H. Packard, M.D.

Trephining.

This operation, as regards the indications for it, has been fully discussed under Injuries of the Head, Vol. I., and only a brief practical description of it need be given here.

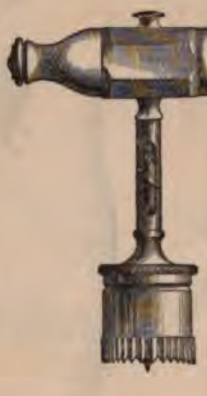
At certain portions of the skull the application of the trephine would be dangerous, since the bleeding from the vessels likely to be opened would be difficult, if not impossible, to control. Such are the line of the longitudinal sinus, and the parietal region over the middle meningeal artery. (Over the lateral sinuses the bone is so thick as to very seldom be the seat of injury calling for operation.) Very often the soft parts are lacerated over the point at which the trephine should be applied; but the wound may require enlarging. In any case the skin should be so divided as to enable the surgeon to raise a flap exposing fully the portion of bone to be operated on. The periosteum should then be scraped up with a rugine or raspatory, sometimes called a lenticular knife (fig. 855), and the crown of the trephine applied. In order to steady the instrument and make it take hold properly, the central pin is at first made to project somewhat, and fixed thus by means of the screw on the shank. There are two forms of trephine — the cylindrical, fig. 856, and the conical, fig. 857.

Fig. 855.



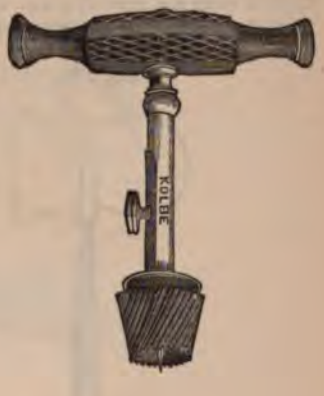
Raspatory.

Fig. 856.



Cylindrical trephine.

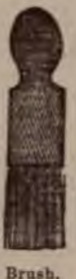
Fig. 857.



Conical trephine.

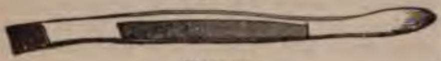
The latter, the more modern form, is the one now generally used. By a quick to and fro movement, the trephine is now made to cut a circular groove into the bone. When it has once taken hold, the pin may be withdrawn, and the cutting continued, with a rapid, steady, and accurate application, but with scarcely any downward pressure. From time to time the instrument should be removed, and its teeth cleared of débris by means of a small brush (fig. 858); the groove should also be cleaned out, and its depth tested, by means of a quill cut to a point like a tooth-pick. Partly in this way, and partly by the feeling communicated to his hand, the surgeon may know when the bone has been sufficiently divided. He now removes the trephine and endeavors, by means of the elevator (fig. 859), to pry up the button of bone. The trephine should never be used for this purpose, as the teeth may be broken in so doing; and the screw-point sometimes recommended to be inserted into the hole made by the pin of the trephine is objectionable, as it may push the button inward if any pressure is made upon it. If the button does not readily yield, the trephine should again be cautiously applied.

Fig. 858.



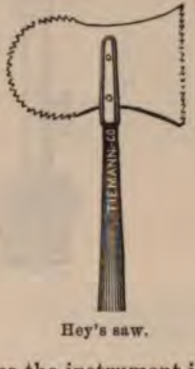
Brush.

Fig. 859.



Elevator.

Fig. 860.



Hey's saw.

Sometimes the instrument is so placed at the edge of the undepressed portion of bone as to cut only with a part of its circumference, and remove a semicircular piece in order to give access with the elevator to the margin of the part driven in.

After the object of the operation has been accomplished, dressings are applied,—the simpler the better.

A smaller trephine may be used for the opening of abscesses in the substance of the long bones. The procedure is the same as in the skull.

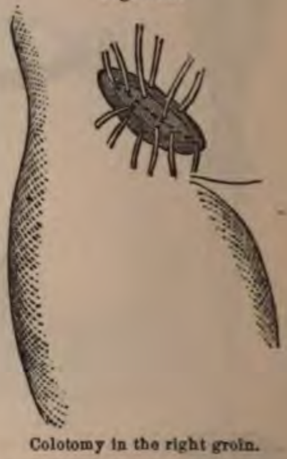
Sometimes, either for dividing bridges of bone confining sequestra, or for relieving diseased conditions of bone, or occasionally in operations on the skull, the instrument known as "Hey's saw" (fig. 860) is employed.

COLOTOMY.

The colon may be opened either in the groin, when the peritoneum is almost necessarily wounded, especially in adults, or in either loin, the left, however, being the one generally chosen. The indications for the operation will be found discussed in VOL. II., under the head of DISEASES OF THE INTESTINES (p. 622), as well as in the article on DISEASES OF THE RECTUM (p. 659).

Littré's operation, or that in the groin, is thus performed. An incision is made parallel with the outer half of Poupart's ligament, to the extent of one and one-half to two inches (in the child); it should be from one-half inch to a scant inch above the ligament. The successive layers being divided, the peritoneum will be exposed, and should be opened; when on the right side, the caput coli, or on the left the sigmoid flexure, will come into view. Sutures should now be passed through the skin and subjacent tissues, including the wall of the gut, and the latter divided. By hooking up the middle portions of the sutures we shall now be at once able to control the bowel, and by dividing the threads, each half will serve to fasten the edge of the gut to the corresponding edge of the skin (fig. 861).

Fig. 861.



Colotomy in the right groin.

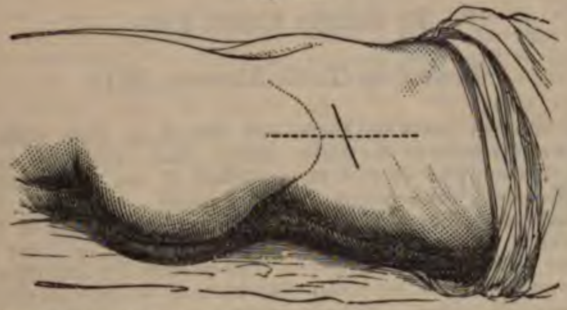
A piece of lint dipped in carbolized oil may now be laid over the wound, and a pad over this, fastened lightly by means of adhesive straps.

Should any small arteries spring during the procedure, they should be at once tied.

Colotomy in the loin (generally called Amussat's operation, though first advocated by Callisen), is performed as follows: The patient is laid on his right side, the right forearm behind the back, and a pillow under the loins, so as to make prominent the region to be operated on. An incision about three inches long is made from the outer margin of the costal attachment of the quadratus lumborum muscle, obliquely outwards and downwards toward the crest of the ilium. The tendinous and muscular structures are then successively divided to the same extent until the mass of fat and areolar tissue about the colon is reached, when the bowel may be readily found, especially if distended with feces. (I have seen this portion of the operation embarrassed by the presence of a large renal cyst.) The remainder of the procedure is precisely like that in the groin.

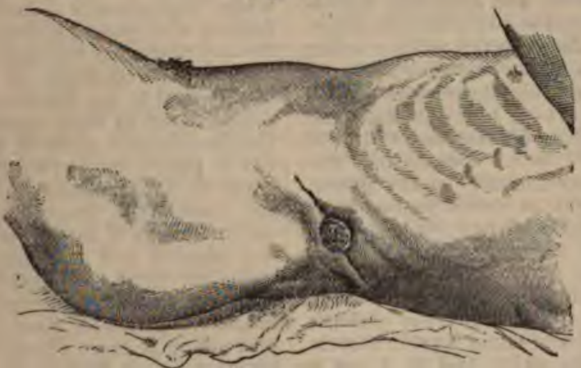
A good rule is always to let the middle point of the incision correspond to the highest point of the crista ilii, as in fig. 862, in which, however, the line is represented as too nearly transverse. A better idea may perhaps be derived from fig. 863, representing the artificial anus as formed and the wound healed.

Fig. 862.



Line of incision for lumbar colotomy. Dotted line indicates situation of descending colon.

Fig. 863.



Artificial anus after colotomy with the oblique incision.

Excision of the Rectum.

This operation can only be properly resorted to in cases where the diseased portion is clearly definable with the finger introduced into the gut, and when the adhesions to surrounding parts are but slight.[1] It is performed as follows, the bowel having of course been previously thoroughly emptied.

A large metallic bougie is first introduced into the urethra, and held by an assistant, the patient being placed in the usual lithotomy position. An incision is next made through the skin at the margin of the anus, encircling the orifice, and keeping clear outside of any disease ex-

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[1] See also note on p. 622, Vol. II.]

isting there. The surgeon next pushes his finger up between the gut and the sacrum, and proceeds to isolate the former by tearing away the areolar tissue all around it. Any bleeding vessels are secured by ligatures as they spring. The diseased portion is now drawn down, and the wall of the bowel divided with scissors. A few points of suture are next introduced to keep the edges of the gut as nearly as possible in contact with the skin, and the operation is finished. Simple antiseptic dressings are applied.]

PLASTIC SURGERY.

By Holmes Coote, Esq.

Revised by T. G. Morton, M.D.

Above three hundred years ago there lived in Bologna a physician of the name of Gasparo Tagliacozzi, who excited far and wide attention and wonderment by his operations and cures. Some regarded him as a sorcerer and necromancer; others as a liar or boaster. No one, however, could comprehend how he accomplished his wonderful cures. Equally little could any one prove aught of evil in his actions or behavior; for he was a man much respected in Bologna; he was Professor of Anatomy and Medicine, beloved of all students, and so honored by his fellow-citizens that they erected to his memory after his death, in the anatomical theatre at Bologna, a marble statue with this insignia of his art—a nose—in his hand. But he had thus far a connection with "necromantic" arts. Before his time surgeons, as occasionally in the present day, had sought to obtain eminence by cutting off arms and legs, by boring the skull, and by burning and cauterizing the flesh. He, however, regarded the matter in a different light; for far from taking anything away from his patients, he endeavored, and found a pride therein, to replace parts which had been lost to them—namely, the nose, lips, and ears—and that not by wood, pasteboard, silver, or gold, but (as was at least then currently believed) by true veritable flesh. There needs no extravagant fantasy to imagine what notice and envy he thus excited, and how he drew upon himself satires both in prose and verse; the more so because his art was regarded as a mystery, and no one could accurately understand whence he obtained the new flesh. So much, however, seemed certain to all, either that he obtained a real human nose taken from another person, or that he cut the organ from some tender flesh, either from chickens or calves, and patched it on the mutilated persons. Tagliacozzi, however, disdaining to spread about himself or his art a mystery, wrote, in the year 1597, a large work in folio, De Chirurgia Curtorum per insitionem, wherein he opened the eyes of people how and whence he made these artificial pieces, namely, out of skin. The well-known lines in Hudibras have become trite, meaningless, and vulgar; while Tagliacozzi's experimental confirmation of a great physical truth lives to be only more honored and believed.

It is no refutation of the claims of Tagliacozzi to say that surgeons are often disappointed in their expectations; that the descriptions given by the early apostles of plastic surgery were florid or exaggerated. The fundamental truths remain the same; the transplantation and reunion of flaps of integument is a proceeding adopted and recognized by all surgeons, although they have learnt that the ultimate result is generally of no more favorable character than to warrant the proceeding in cases where the patient experiences a positive evil. We do not quite accompany Dr. Fritze,[1] when he says, in his glowing language, "A perforated and corroded fleshy knob, which brings woe to the possessor who carries it on his shoulders, and horror to every one else, is converted by plastic surgery into a human physiognomy, and gives back to the discarded and avoided person both life and society; the eye, which, deprived of its natural covering, becomes dry and inflamed, and would withdraw itself, but in vain, with convulsive efforts, from the destructive influence of light and air, seeking the repose which avoids it, is covered again with protective eyelids, and regains life and sleep; a mouth, puckered up and grown together like an eyelet-hole, for which no food is suitable save soup and thin broth, and whose expulsive articulation resembles the cry of the wild beast, again gives forth human sounds, reopens, and allows the patient both to eat and speak. Have I yet," he says, "occasion to relate that plastic surgery has the power to heal both urinary and fecal fistulæ, and thus to remove the greatest physical suffering with which man is afflicted in this world?"[1] Let us divest the subject of this high coloring and romance; and, while acknowledging its utility, remember that "the artificial nose, even the most complete, can never fully equal the natural; that the patient need never expect it." "Nature ever triumphs over art, and here is the boundary between what is godlike and human."

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[1] Die Plastische Chirurgie, an excellent work, to which the reader may be referred for a history of the art of Plastic Surgery.

Certain subjects, those indeed most commonly illustrative of plastic surgery, will in this work be treated under other heads. Thus, fissured palate, etc., comes under the head of DISEASES OF THE MOUTH; entropium, ectropium, and closure of the lacrymal sac, under that of DISEASES OF THE EYE; imperforate anus, under SURGERY OF CHILDHOOD; recto- and vesico-vaginal fistula, under DISEASES OF THE FEMALE ORGANS OF GENERATION. We propose, therefore, here to deal more with general principles, and to apply them to such subjects as are not included in the above headings.

Now all deformities, whether remediable or irremediable by surgical operation, may be classed under two heads: the congenital, and the non-congenital; and this distinction must be borne in mind in most of the cases we are called upon to treat. A congenital deformity implies an arrest of development, possibly a congenital deficiency of parts, or a relation such as should exist naturally only in fœtal life. In non-congenital or acquired deformity, parts already formed and normally proportioned have been injured or destroyed. There are but few exceptions to this rule. The treatment of the former is in severe cases more unsatisfactory than that of the latter. For instance, a simple congenital fissure of the lip, constituting hare-lip, may be united in the usual way; but there is mostly some abnormal marking on the integument, which ever afterwards indicates the operation which has been performed. Moreover, the fissure may extend into the hard and soft palates, or the irregularity of development may influence the position of the incisor teeth. The case is obviously more complicated than one of simple division of the upper lip by accident or surgical operation; and the surgeon should bear this point in mind; for although, as regards the mouth, the statement is obvious enough, there are other situations where want of attention to the law of fœtal relations may be followed by serious consequences. When the bladder is open in front from congenital defect (extroversio vesicæ), the fissure in the organ and in the abdominal parietes is not the only defect. Bladder, prostate gland, and peritoneum, rectum and pelvic bones, retain very much of those relations which existed at the moment when the bladder failed to close. In other words, from that moment parts grew in size, but ceased to be developed to the normal bearings of the adult. Should the surgeon in such a case endeavor to establish a recto-vesical fistula (as has been several times attempted), by passing a trocar from the rectum into the bladder in order to divert the stream of urine, he will make the discovery that there is rarely any safe spot which the instrument may traverse: the prostate gland is small; the peritoneum comes down to its very border, as it would in the young infant; the bladder is more of an abdominal than a pelvic viscus. Hence fatal peritonitis ensues before the surgeon has had time to establish those conditions which he trusted would enable him to close, by a plastic operation, the abdominal fissure through which the urine escaped.

The powers of repair and of reproduction in man, upon which depend the success of all plastic operations, are very much more limited than in the lower animals. We need not here dwell upon the well-known instances of the re-formation of the lost leg to the salamander, or the lost claw to the crab, but may remark that in man the hair, the nails, the epidermis, and epithelium seem alone to possess the power of complete regeneration. It is doubtful if, under any circumstances, tissues of even the lowest organization and of the lowest chemical characters, such as the cellular and tendinous, become replaced completely, when once removed, with all the characters they had before. In 1858 I had the opportunity of examining two Achilles tendons, which had been subcutaneously divided at periods of two and three months previous to the death of the patient;[1] and it was there seen, after making a longitudinal incision, that the divided ends of the normal tendo Achillis, two inches apart, were united by a light gray semi-transparent structure, quite different from natural tendon, and readily distinguishable to its very boundary.

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[1] Op. cit., p. 3.

[1] Medical Times and Gazette, Jan. 9, 1858.

Whatever the microscope may reveal, the fact is undoubted, that when the entire thickness of the skin has been destroyed, the tissue which replaces it never exhibits the same characters or perfection as before. A superficial layer of skin may be disorganized, when repair goes on by granulation, and no trace of the injury after a time is perceptible. But the case is otherwise when the whole thickness of the skin has perished. The smooth white cicatrix retains its own characteristics, and contracts for months and even years, gradually drawing closer around its decreasing circumference the surrounding integument, and acting, though slowly and gently, yet with a force that no tissue, however hard, can resist, distorting the features, and exercising an influence on the shape of the growing bone and on the direction of the teeth. Let no surgeon, who hopes to remove a deformity, ever trust to the persistence of a large cicatrix; let him likewise remember that every incision which he makes involves the formation of this newly effused and readily contracting uniting medium; and he may perhaps be more wary than he has hitherto been in attempting the removal of contractions by operation.

In plastic surgery the operator avails himself of the true skin, with the subcutaneous areolar and fatty tissues; sometimes likewise of the mucous membrane. Fritze justly remarks that the transplantation and union of bone-fragments, as well as of teeth and hair, is very problematical. Walther[1] speaks of the reunion of a piece of trephined bone; Weisemann,[2] of the adhesion of teeth; Dieffenbach, of the transplantation of hair. Hunter's experiments upon this subject are also well known. They are all, however, of more physiological interest than practical utility.

"We have to deal in plastic operations with the integument only," says Fritze;[3] "and can as little make a new nose out of a fowl's breast, as cut out and form a similar organ out of the thick muscular flesh of the arm." The flap for transplantation should be taken from the individual on whom the deformity is to be rectified. Thus, if a new nose is to be formed, the skin should be taken either from the immediate proximity of the damaged organ, as the forehead or cheeks, or else from a part which can be readily approximated, such as the forearm. Bünger relates a case of partial success in the formation of a new nose on a lady by a piece of integument completely cut away from the thigh:[1] and Hoffacher, who was officially appointed to attend at the duels frequent among the students at Heidelberg, mentions some remarkable instances, which are attested by Chelius and Velpeau, of the reunion of parts completely sliced off by sword-cuts, *e. g.*, portions of the nose, lips, or chin. But no such license can be allowed in plastic surgery; the flap must retain its connection to the adjacent living structure by a pedicle, which is to be severed only after complete union and cicatrization of the raw surfaces. The idea of taking the flap of integument from another individual, and binding the two persons together until union shall have taken place, is preposterous to English notions; although stated to have been entertained and practised in eastern countries, where plastic surgery has been known from time immemorial.

The flap of integument, separated from its connections by the knife, and hanging only by the pedicle, becomes at first blanched and white from loss of blood, and also somewhat shriveled or shrunken. After the hemorrhage has ceased, it may acquire a marbled aspect from irregular accumulation and stasis of the blood; and the temperature perceptibly falls. Soon, however, the redness and warmth return to it in its new situation, and hemorrhage may commence from its under surface afresh. Thus it continues for some hours, the flap sometimes paler, sometimes redder, as the vitality loses or acquires power, until ultimately, when circumstances are favorable, the latter condition prevails, and even puffiness and swelling may supervene before the parts regain their normal aspect.

Now, inasmuch as the success of all these operations depends upon delicacy of manipulation and extreme accuracy in detail, let me warn the student that there is no more frequent source of failure than the presence and persistence of a clot of blood, whether primarily or secondarily effused, under the flap. Hemorrhage is an evil in all stages of plastic surgery; and therefore the surgeon is accustomed to wait before attaching the bleeding flap to its new connection, well knowing that no time is more favorable for the effusion of plastic material than when the parts are dry and even somewhat glazed. He likewise keeps the patient moderately cool, maintaining the natural heat of the body on the one hand, and avoiding all causes likely to produce excess of action on the other; for should bleeding recur, the wound may need to be reopened.

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[1] Th. v. Walther, Wiedereinheilung der bei der Trepanation ausgebohren Knochenscheibe.

[2] J. H. Weisemann, De Coalitu partium a reliquo corpore prorsus disjunctarum, Lipsiæ, 1824.

[3] Op. cit., p. 5.

[1] Bünger, Gelungener Fall einer Nasenbildung aus einem völlig getrennter Hautstücke aus dem Beine. See Gräfe and Walther's Journal, Bd. iv., p. 569.

Among the accidents which befall the transplanted flap is one to which particular attention has been directed by Mr. Skey.[1] "It will occasionally happen," he observes, "after some days from that of the operation, that the new structure begins to lessen in size, and continues to diminish, till it becomes almost absorbed. My experience in nose-making, though not small, is not sufficiently great to enable me to explain this fact; whether owing to the small size of the stalk, or to the want of general activity in the circulation—but such is the case." That the shrinking of the flap is rather due to the latter than to the former cause, was illustrated by a case under my own care in St. Bartholomew's Hospital. In 1859, a boy was admitted suffering from disease of the knee and symptoms of early tubercular deposit in the lungs. I amputated the limb according to the method proposed by Mr. Teale; that is to say, by making a long rectangular anterior flap of integument, and bringing it under the stump to unite with a short flap at the posterior aspect of the limb. The case terminated favorably; but with the cicatrization of the wound the anterior flap shrunk so considerably, that it but little exceeded in size the smaller posterior one to which it had been united. The limb had the aspect of having undergone the usual flap operation.

Gangrene appears about the third or fourth day. If the flap retains its vitality beyond this time, union generally proceeds without interruption. The parts assume a grayish color when mortified, look soft and pulpy, and the cuticle loosens; or the flap may become dry, shrivelled, and withered. But even under these circumstances let not the surgeon remove it; he should rather cover it with cotton-wool or a soft bread-and-water poultice, or with water-dressing, *i. e.*, wetted lint covered with oiled silk or gutta-percha; for he cannot tell either how far or how deep the loss of vitality may extend. The edges of the wound alone may die; or the superficial parts may be thrown off. If even the smallest portion of skin remain in its new situation, it will afford the patient partial relief, or serve as a groundwork materially to facilitate any future proceedings. I will add only this advice: if the wound happen to be going on unsatisfactorily, the surgeon should cover it up, and abstain from frequent examinations. He will see in a few days, without repeated inspection, how much nature has been enabled to effect.

It is unnecessary to speak of the many inconveniences attending an attack of erysipelas after the operation, inasmuch as this disease has been described elsewhere. Every proper precaution should be taken to prevent such an accident: the room should be clean and airy; the dressings light, and easily though not often changed. The general condition of the patient should be such as to render unnecessary purgative or other disturbing medicines; he should take such nourishment as his circumstances best admit. By preserving the standard of health as near as possible to its normal state, we put the patient in the best condition to resist injurious morbid influences.

The object of the surgeon in all cases is to obtain union by *first intention*. The surfaces which we wish to unite should be held accurately together, with the smallest amount of irritation, until a layer of plastic lymph is exuded; an event which takes place at any time between twenty-four hours and three days.

The flap of integument having been cut to the proper size, cleaned of extravasated blood, and fashioned to its new situation, we proceed to inquire into the best method of holding it there until nature has accomplished her part. Although the employment of metallic sutures is not a modern discovery, yet too much credit cannot be given to Dr. Marion Sims for his energetic advocacy of their use, and for the earnestness with which he has worked out their practical application. Indeed they may be said to have fallen into disuse until the publication of his anniversary discourse before the New York Academy of Medicine.[1] Few surgeons will fail to endorse his opinion, that "in plastic surgery it is the greatest desideratum." "In May, 1850," he observes,[2] "a gentleman had the misfortune to lose a good part of the left ala nasi. In the operation eight interrupted silver sutures were used. They were removed on the seventh day: union was perfect, and he soon went home, with some slight tumefaction of the parts, which gradually subsided. In the course of a fortnight he returned, saying that in wiping the perspiration from his face, he discovered some pricking substance at the seat of the operation, which he supposed to be a bit of wire. He was right; the wire was there, but easier felt than seen. It was removed, and found to be half an inch long; it had remained there four weeks, producing no sense of soreness, and no inflammation or suppuration, as a silk ligature would have done; thus establishing the great and important principle that silver was as innocuous as lead, and, like it, might become sacculated, producing no irritant or poisonous effect whatever." In 1852, a little boy, some eight years old, received a blow on the upper lip, near the left commissure, cutting it through for three-quarters of an inch. Three interrupted silver sutures were applied, and no other dressing. Dr. Sims saw no more of him till the ninth day: "union was perfect, the wires remaining precisely as he had placed them. Their removal was like that of a delicate ear-ring from the ear long used to wear it." In 1853 the same surgeon performed a serious operation on a gentleman suffering from cancer of the lip. The patient went home (some 80 or 100 miles) immediately after the operation, and returned to Dr. Sims in a week. The cut surfaces of a V-shaped incision had been united by four interrupted silver sutures: union was perfect throughout, the wires having produced no inflammatory effect whatever.

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[1] Skey, Operative Surgery, 2d. edit., p. 524.

[1] Silver sutures in Surgery; the anniversary discourse before the New York Academy of Medicine, delivered on November 18, 1857, by J. Marion Sims, M. D., Surgeon to the Women's Hospital: New York, 1858.

[2] Op. cit., p. 32.

The method of introducing the wire sutures will be hereafter described;[1] the time of their removal must be left to the discretion of the surgeon; probably the mean time would be about a fortnight.

The shotted suture is no modern invention. Two or more pieces of silver wire are passed across any deep wound, at equal distances from each other, by means of a slightly curved needle. The two extremities of each wire are passed through a small hole drilled in a bar of plated metal, the length of which should exceed that of the wound. The wires are first fixed beyond the bar, on one side of the wound, by means of perforated shot, about two of which may be strung on each wire, and compressed by means of a pair of pliers. The opposite end of each wire being now strung with perforated shot, the wound is drawn together, the shot pushed up to the bar and compressed, as on the other side. The superfluous wire may be cut off with the cutting-pliers.

Rhinoplastic Operation.

Tagliacozzi's operation for making a new nose was as follows: After proper preliminary measures regarding the general health, the patient was made to sit during the operation, supported by an assistant; the operator stood in front. The piece of skin to be transplanted was taken from the left upper arm, over the biceps muscle. The surgeon raised the skin by means of a pair of broad-bladed forceps, of somewhat peculiar shape;[1] and when he had satisfied himself that he seized a piece of sufficient size, he closed the blades, and fixed the handles by means of a simple clasp. He then passed a double-edged knife through a horizontal fissure in the broad blades of the forceps and through the skin, thus separating the latter from the subjacent muscular tissue, but leaving it attached by a pedicle, both towards the shoulder and the forearm. A piece of lint soaked in oil or simple cerate was inserted under the flap, to prevent union from taking place; and it was retained in its position under the skin till the fourth day, when the dressing was changed, and renewed daily until suppuration was established. If the flap had then begun to thicken and the edges to become incrusted, it was cut free at its upper end, presenting a line with the convexity directed upwards. It was then most carefully dressed and attended to, until the under surface had become cicatrized as far as possible. Remaining attached by one extremity to the arm, it underwent a process of thickening, contraction, and wrinkling, accompanied with the growth of hair, which Tagliacozzi fancifully compared to different stages of growth. About the fourteenth day after the second operation, it was considered to be in a state of maturity. The patient was purged, cleanly shaved, and supplied with a leather jacket, which was to serve as a support to the arm when raised to the face. The jacket, or jerkin, consisted of a cap and of a breast-piece. The edges of the flap and of the nasal aperture were then pared, and the two parts were prepared for union by sutures.

The arm rested in a semiflexed position, on a cushion, while the ligatures were being inserted and tied; it was retained in that position by a leathern apparatus, the different parts of which were attached to the cap and breast piece by bands and straps [fig. 864]. The patient was kept in bed, under a strictly antiphlogistic treatment. The ligatures were taken out on the third to the fifth day; but the flap was left resting upon some lint or rag covered with albuminous material until the twentieth day. The surgeon then loosened part of the arm-straps, severed the remaining attachment of the flap to the arm, and covered the wound with proper dressings. If the septum nasi was deficient, a piece was taken from the upper lip by a subsequent operation.

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[1] See MINOR SURGERY. All the common forms of suture will be found described in that essay.

[1] See Fritze, op. cit., plate ii., fig. 1.

[Fig. 864.

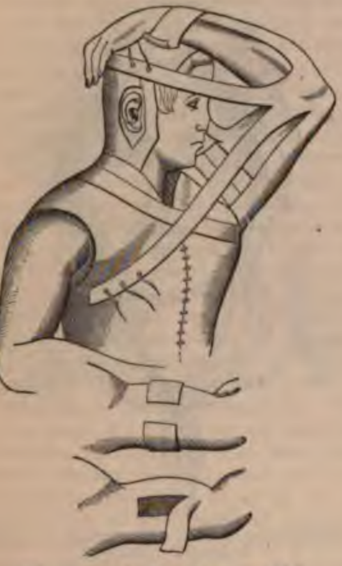

Diagram of Tagliacozzian method.]

According to the spirit of the age in which he lived, Tagliacozzi invested the stages of the operation, the instruments and apparatus, with unnecessary names; he is likewise tediously minute in his description, of which the above is a very brief outline. But he has a fair claim to the renown which has attached itself to his name, for the boldness with which he instituted his proceedings, and the care with which he followed his cases to their completion. Many have attempted to adapt the different stages of Tagliacozzi's operations to the ideas of modern surgery; but I think we may affirm, that the practice of taking the integument from the arm is exploded, and that in all cases the surgeon now prefers to avail himself of the parts adjacent to the nose, namely the forehead or cheeks.

[The proposition has lately been made, but I do not know whether it has been practically attempted, to construct a new nose by attaching part of one of the fingers to the face, the idea being that the presence of a solid bony basis would prevent one cause of failure, viz., the sinking in of the transplanted substance into a shapeless knob, only a degree less hideous than the original deformity. In all but some minor details, the procedure would closely resemble the old method of Tagliacozzi.—P.]

Among those who have performed the rhinoplastic operation with skill and success, Mr. Skey holds a prominent position. The disease to which the destruction of the nose may be usually assigned is lupus, which having involved the cartilaginous structure, leaves the bone untouched. "If the bones be entire," he says, "the operation is more likely to be a successful one. If the bones be destroyed, the condition of the patient precludes the resort to the best operation, and the result is far less promising, from the loss of the arch on which the superstructure is laid."[1]

Before proceeding to the operation, the surgeon should take the dimensions of the required organ in card, paper, or gutta-percha. The new material is taken from the forehead, and connected to the root of the nasal bones by a narrow stalk-like process. When the flap of the integument is insulated, this stalk is twisted, so as to enable the part to be brought down vertically. The integument, continues Mr. Skey, should be removed longitudinally from either half of the forehead, running outwards towards the temple, in order to render the twist as inconsiderable as possible; and when the admeasurement is complete, at *least a quarter of an inch on all sides* should be allowed for the contraction of the skin; in fact, the flap can hardly be made too large, and it is surprising how slight a stalk is requisite to carry on the circulation. When the card has been fitted over the meatus, it should be laid out on the forehead, and all its dimensions extended and marked in ink. The part that is to represent the columna should be very broad, probably more than half an inch. Mr. Skey puts the patient in the horizontal posture. He commences by paring the margin around the nose pretty freely, in order that the exposed edge should be sufficiently large to receive the corresponding margin of the new integument; and the skin on the lower surface of the ossa nasi should be entirely removed by the knife. When this stage of the operation is completed, a deep incision should be made along the inked line on the forehead, slowly and cautiously, for one slip of the knife may render the whole operation nugatory. The lower edge of the incision will pass across the fibres of the corrugator supercilii, which muscle may be detached with the integument. If the knife be so held as to slope a little inwards, it will give an acute angle to the cutaneous surface of the flap, by means of which the two surfaces may be adjusted with more precision as regards the continuity of surface. When the flap is detached in every part except at the stalk, which of course is most carefully preserved from injury, the wound should be left to bleed, and no attempt made to adapt the surface until the bleeding has *entirely ceased*. Before leaving the flap, it is better to scoop out a little of the substance along the central line of the columna, in order that, by being hereafter compressed, it may fold together and resemble as much as possible the original structure. When brought down, the columna should be first united to the raw surface made for its reception. There is some difficulty in applying the suture in this situation, from the density of the structure forming the base of the nose. For this purpose, a much-curved needle must be employed, which should embrace a considerable piece of the cartilage. It may be advisable to employ two sutures instead of one. The sides are then first united by about three good-sized sutures, and the intervals adjusted as exactly as possible by the aid of six, eight, or ten of the finest sutures that can be employed (fine silver-wire sutures are now used). The nostrils should be elevated by means of pieces of cork and cotton-wool, and generally pressure of moderate force made laterally by the same material and a bandage, care being taken to prevent all pressure on the dorsum. The wound on the forehead should be drawn together with good plaster. At the expiration of about a month, or as soon as the new parts have firmly united, the lump, always caused by the twisting of the stalk, should be pared away, and the knife applied to remedy any positive deformity in the line of the cicatrix.

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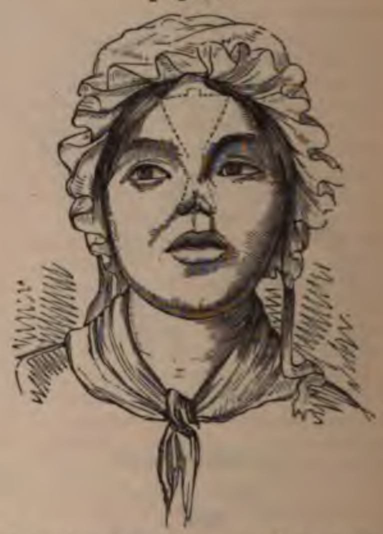
[1] Skey, Operative Surgery, 2d edit., p. 521.

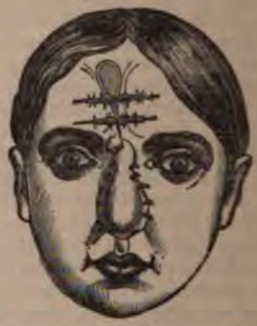
This operation of bringing the flap from the forehead is designated the Indian operation, and was first introduced into Europe by Mr. Carpue, in 1814, who improved upon the original operation by adding a septum nasi, and by the employment of sutures. He was soon followed in Germany by Gräfe, by Dieffenbach, and by others; and the results have been successful. At the end of three or four days the flap will be found tumid, warm, and sensitive, but pale; and at this time, Mr. Erichsen recommends that the plug in the nose be changed, lest it be rendered offensive by the discharges. He rightly, however, adds, "that its withdrawal, and the substitution of another, must be done with the greatest gentleness, the surgeon bearing in mind that any undue pressure or traction may destroy adhesions, and prove fatal to the vitality of the flap."

[Fig. 865.



Rhinoplasty. From a case operated on by Sir William Fergusson.]

[Fig. 866.



New nose the day after operation.]

Some surgeons make the columna nasi in the operation from the upper lip, as in the method proposed and adopted by Tagliacozzi. In cases where there has been great destruction of the bones, or where, as after syphilitic disease, the nose becomes completely depressed, Larrey and Dieffenbach have revived the operation of Celsus, and have taken the integument from the cheeks. "A young girl had lost the proper bones of the nose, the vomer, the greater part of the nasal apophysis, the malar bones, and the lamellæ of the ethmoid. The integuments were folded into the nasal fossæ, and presented the general aspect of a countenance sunken by death. Dieffenbach made along the sides of the depressed nose, in its whole length, two incisions penetrating to the bone. There resulted a band of skin, isolated, and adhering only at the upper and lower ends; it was broader in the latter than the former: a vertical incision along the middle line divided this portion of skin into two. The lateral incisions were continued inferiorly by two semilunar incisions, which separated the alæ nasi from their external connections. He dissected these two flaps from below upwards, separating them completely from the nasal cavities into which they had been folded. He then separated, for some distance, the thick substance of the cheek. Having completed these steps, he united by six sutures the edges of the median incision, and brought into contact the edges of the lateral incisions by eight sutures. The nose then seemed to regain some of its natural prominence and form, the nostrils being kept distended by pieces of lint soaked in oil. As the last stage of the operation, he approximated the separated and dissected cheeks, under the nose, by passing through their substance a long needle.'"[1] We mention this operation, not in terms of commendation, but rather to show what has been attempted and done with some share of success. We must, however, warn the young surgeon that, in these *opérations de convenance*, the sources of mishap are numerous, and disappointments will occur in spite of the endless variety of modifications adopted by different surgeons. Mr. Skey gives a good piece of advice when he says, "let it be the patient who urges the operation." The operator will be thus released of some share of responsibility. "In one of Mr. Liston's early cases, the new nose sloughed under an attack of inflammation; in another, hemorrhage occurred under the flap, on the ninth day, to the extent of more than a pint of blood. Lastly, the operation is not without its dangers: Dieffenbach lost two patients out of six on whom he operated in Paris, their constitutions being probably in an unfavorable state."[2]

In the construction of a new ala nasi, the surgeon takes the integument from the cheek. He must trust to his skill, and the circumstances of the case, to guide his incision.

Cheiloplastic Operations. Operations for Defects of the Lips.

Hare-lip.—The well-known deformity called hare-lip is a congenital fissure of the upper lip. I never met with a case in which the under lip was similarly affected; but a few such cases are on record. The fissure may be single, generally a quarter or a third of an inch from the mesial line—more often, according to Malgaigne, to the left than to the right—and presenting at the lower angle a rounded and cicatrized appearance, which must be removed at the time of operation. Or it may be double, in which case there are two fissures, separated by a median flap. The deformity may be complicated with fissure of the bony or of the soft palate; the fissures in the former may be double. There may be fissures of the soft palate without any corresponding cleft in the lip.

The piece of bone behind the median flap in double hare-lip and double fissure of the palate is said to be the homotype of the premaxillary bone in the lower vertebrata, and it generally contains the two front incisor teeth. Its size and the amount of projection vary considerably, but it is always a source of operative complication.

We do not propose to enter into the subject of arrest of development to which this deformity is due, but remind the reader of the statement already made, that in very many cases there are other congenital deficiencies coexistent. Among these rank foremost the teeth, which are often a source of subsequent trouble. I had under my care an infant with fissure of both hard and soft palate, double clubfeet, with deficiency of the extensor muscles, and want of muscular power in both hands. It is obvious that in such cases surgical interference should be postponed.

The treatment of hare-lip is of very ancient date. We propose to confine the following remarks to the best mode of rectifying it as at present practised. The operation should be performed as early as possible, certainly before dentition has commenced. The closure of the fissure not only gives to the child the facility of sucking even immediately after the operation, but leads also to greater regularity in the development of the teeth. Delmas operated two hours after birth! Mr. Lawrence has often operated between the third and fourth week. I have frequently done the same. Sir W. Fergusson recommends about the sixth week, which Mr. Erichsen regards as the time of election. Mr. Skey doubts the advantage of its being undertaken at a period earlier than three or four months. Richter and Bell recommend a still later period. But if the child is strong and well nourished, a month or six weeks is about the proper time. Chloroform should of course be given, as infants become readily affected, and, as far as experience goes, with the smallest amount of danger.

Operation.—The child having been swathed in a piece of sheeting, and the lips being held by an assistant, who grasps them in their whole thickness to prevent hemorrhage from the coronary arteries, the surgeon first finds it necessary to separate the mucous membrane and frænum with a scalpel from the alveolar border of the upper jaw, in order that the edges may be the more easily approximated. He then seizes the lower angle of each of the sides with fine sharp-pointed spring forceps, and either with a sharp knife or with knife-bladed scissors pares the edges effectually. Without waiting for the cessation of hemorrhage, which would blanch the infant, the surgeon then passes the hare-lip pin deeply through the substance of the lip, commencing from one-third to one-half of an inch from the cut surfaces. A strong silken thread is wound round the pin, bringing the cut edges into contact, in the form of a figure of eight. I then prefer to introduce a fine silver suture at the upper end of the wound to bring the nares into shape, and a second at the red of the lip to preserve the continuity of that important feature. The child is allowed to sleep, or to suckle if it pleases.

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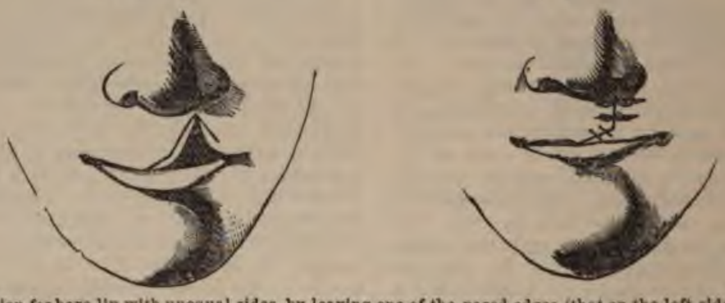
[1] Malgaigne, Méd. opérat., 1843, p. 421.

[2] Erichsen, Science and Art of Surgery, p. 670.

Most surgeons prefer the two sutures to the practice of introducing a second hare-lip pin, because the former holds the parts more immovably in contact. I operated some time ago on a child, in whom I omitted to put the suture near the nares. Soon after the operation catarrhal discharge from the nose came on; the silk around the hare-lip pin became softened and loose before its time, and the fissure partially reopened. Mr. Lloyd was in the habit of preserving a small slip of the flap of the long half of the lip (when such inequality exists), and of attaching it to the under surface of the shorter half, that there might be no notch or fissure when cicatrization had taken place.

Fig. 867. Fig. 868.

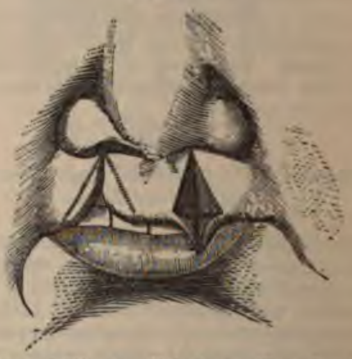


Operation for hare-lip with unequal sides, by leaving one of the pared edges (that on the left side) attached, and implanting it into the opposite flap, the edge of which has been sloped to receive it. (From Holmes's Surgical Treatment of Children's Diseases.)

Mr. Skey observes: "In consequence of the greater extensibility of the lower than the upper part, the result of the operation for hare-lip is to leave a permanent deformity, caused by the retraction of the cicatrix, and the formation of an angle below, at the point of union. To obviate this evil, the lines of incision should be curved inwards."[1] Different ways of varying the incisions, suitable to each particular case, must suggest themselves to the surgeon's mind before he commences his operation. The wedge-shaped slip depicted (figs. 867–868) preserves the continuity of the end of the lip.

The proceeding of Clémot (de Rochefort) and of Malgaigne (fig. 869) also merits attention. The incisions are made from above downwards, but they do not completely detach the flaps. The exposed and everted surfaces are brought together, as are the other cut surfaces, and if the tubercle which results is too prominent, it is removed at a subsequent operation. But the parts once united shrink and adapt themselves to their new relations.

Fig. 869.



Operation of Clémot or Malgaigne. (From Larcher's translation of the same work.)

A third operation is represented in figs. 870–871; a fourth (figs. 872–873), that of Giraldes, enables the surgeon to bring forward a portion of the cheek, and to prevent undue tension. Further information on these operations may be obtained from Mr. Holmes's work on the Surgical Diseases of Children, or from the French translation of the same work by Dr. O. Larcher.

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[1] Operative Surgery, p. 531.

The hare-lip pin should be shortened at both ends by means of cutting pliers. Some surgeons have omitted the pins, and substituted the silver sutures; but, although union may be thus obtained, I am of opinion that a part so movable as the upper lip, requires the firmer support of the strong metallic pin.

Fig. 870.

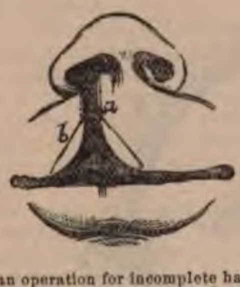


Fig. 871.

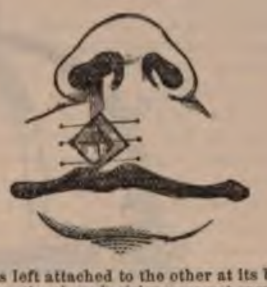


Diagram of an operation for incomplete hare-lip. Each flap is left attached to the other at its base, the incisions *a*, *b*, not reaching to the red edge of the lip. [N. B. In practice these incisions are not carried so low as they are here represented.] (From Holmes, op. cit.)

It is customary to remove the hare-lip pin about the fourth day. It should be gently withdrawn, and if the dried figure-of-eight piece of silk remain adherent, it may be left on the lip, where it serves as a plaster. There are some who remove the pin on the third day; others who leave it till the sixth or seventh. In the one case the union may be still too weak to hold; in the other, the pin may have cut its way out by ulceration. If the sutures are of silk, they should be taken away in twenty-four to forty-eight hours; if of silver they may remain as long as the surgeon thinks proper. At the time of the removal of the hare-lip pin, the cheeks should be well pressed towards the middle line by an assistant, that no accident may occur to the newly-united parts by the act of crying, which commonly ensues. Then a long piece of adhesive strapping, a quarter of an inch wide and three-quarters of a foot in length, should be passed, across the wound round the head just over the ears two or three times, by which the parts are protected against all strain. I think the strapping preferable to Mr. Hainsby's spring cheek-compressor (fig. 874); but the instrument accomplishes satisfactorily the same purpose.

Fig. 872.

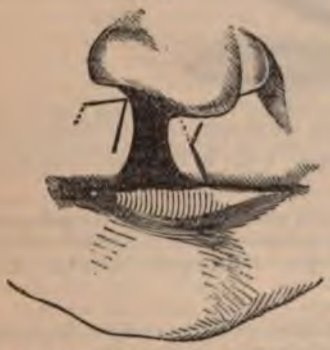
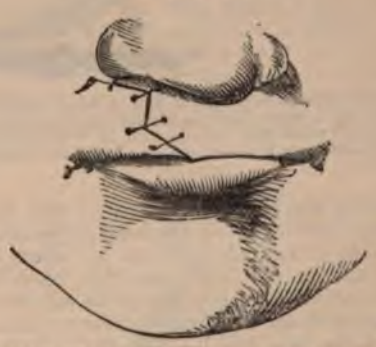


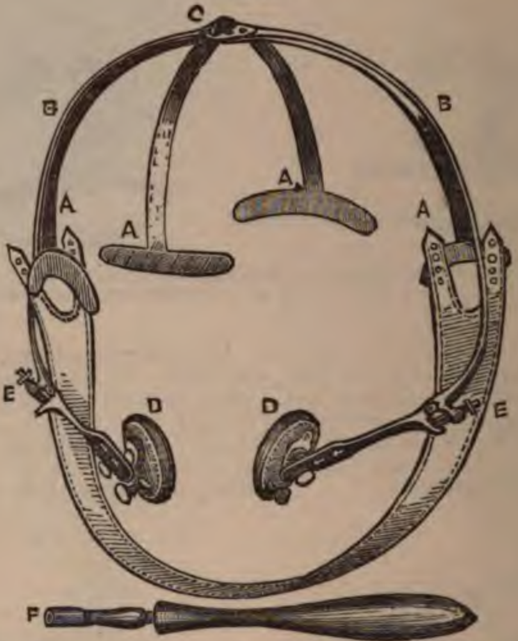
Fig. 873.



Giraldès' operation for complicated hare-lip, in which one flap is left attached by its upper, and the other by its lower end, and the two are dovetailed together. (From Thévenin, Considérations sur le Traitement du bec-de-lièvre compliqué.)

In cases of double hare-lip it is safer practice to operate on and to unite the fissures separately. Some surgeons, however, have recommended that both fissures should be pared simultaneously, and that the hare-lip pins should be pushed through the central flap. Such a proceeding unnecessarily increases the chances of accident. When the bone containing the incisor teeth projects so far forward as to interfere with or to prevent the easy apposition of the pared edges of the lip, it may be cut away by bone-pliers at a separate operation; and this measure is not uncommonly necessary. But in many cases gentle pressure will make it recede in the course of a few weeks; a proceeding strongly advocated by the late Sir A. Cooper, who objects to cutting away the bony projection. A case is related in which an infant of two months old, suffering from hare-lip and projection of the bone, was subjected to pressure for a period of three months; when the bone had been so effectually depressed by means of a kind of spring-truss, which was worn several hours daily, that the soft parts admitted of being brought over it with tolerable facility. Union followed very well.[1] Desault applied pressure by means of a band tied tightly behind; and it is said that in one case he accomplished his purpose sufficiently in eighteen days. M. Gensoul seizes the piece with strong forceps, partially breaks and forces it into the perpendicular, and this proceeding has proved successful. This operation has been adopted in St. Bartholomew's Hospital, and also with good result; the preservation of the incisor teeth being an object of considerable importance. If the piece is connected to a perfect septum nasi, it is a good plan to cut a triangular piece (base downwards) out of the latter before applying a band to press back the projection.

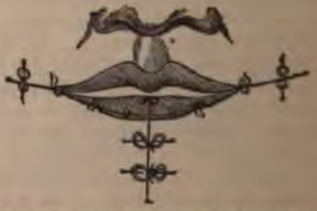
Fig. 874.



Compressor of Hainsby. A, A, A, A. Skull-piece formed of four bands of steel, to maintain gentle pressure on the head, supported by an elastic chin-strap. B, B. Rigid circle or stem supported on the band of steel. C. The screw which fixes the stem. D, D. Pads, articulated on the stem, with free joint, to support the cheeks. E. Headed screw by which the pressure of the pads can be increased. F. Key for the screw. (From Larcher, op. cit.)

Restoration of the lower lip.—The restoration of a part of the lower lip, which has been lost by accident or disease, is accomplished by a simpler operation than that for the formation of a new nose. The new structures must be taken from the cheeks, which readily afford a sufficient supply of both skin and mucous mem-

Fig. 875.



Cheiloplasty—wound brought together.

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[1] Cooper's Dictionary, p. 594, 1830.

brane. Malgaigne observes, that he had described the proceeding, in 1834; and that the late M. Bonnet, of Lyons, had put it into practice. Serres, of Montpellier, has given a full account of it in his interesting work; but the principle dates back as far as Celsus.

Operation.—We suppose the case to be one of cancer affecting the lower lip. All the degenerated parts must be taken away either by a V-shaped incision, according to ancient usage, or by two vertical incisions passing down to the base of the jaw-bone, and united there by a transverse incision.

In the first instance, there will be the loss of a triangular piece of the lip and chin; the angles of the mouth must then be prolonged by a transverse incision on each side into the cheek, so that two triangular flaps are obtained. The borders of the V-shaped incision are then united by suture; while, as regards the upper border, all that is not wanted for the formation of the new lip, which is formed out of the substance of the cheek, is united to the part with which it is in contact. The mucous membrane in the mouth should be united to the skin by fine sutures.

When the loss of substance is quadrilateral, two other incisions, parallel to the two continued from the commissures of the mouth, must be made along the base of the jaw. Two quadrilateral flaps may then be dissected from the bone, brought forward, and united in the median line by sutures, as in the former operation. This last method, says Malgaigne (from whose work the preceding passages have been taken), is but the proceeding of Celsus, badly understood by his translators; a proof that in order to translate a surgeon, it is not only necessary to know the idiom that he uses, but likewise the science of which he treats.

It follows from this proceeding, that the cheeks alone contribute to form the lip, the free border of which is constituted by the bleeding border of the horizontal incision. Thus, the new lip contains the muscular fibres belonging to the orbicularis and its antagonists; it is covered behind by the natural mucous membrane, and this membrane may be turned over and united to the skin, so as to resemble more closely the natural feature.

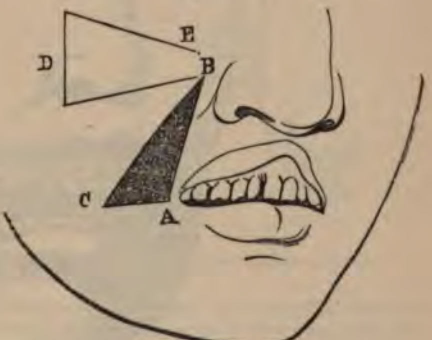
The modification of this operation commonly performed in this country corresponds in principle so closely to the above, that further reference is unnecessary.

Mr. Syme has introduced an operation by which the cancerous ulcer of the lower lip is first removed by two incisions, extending from the angles of the mouth to the chin, and uniting below, so to include a piece of triangular shape. The cuts are then carried obliquely downwards and outwards on each side, under the body of the jaw, and made to terminate in a slight curve outwards and upwards. The flaps thus formed are detached from their subjacent connections, and the whole raised upwards, so that the original triangular incision comes into a horizontal line, and is made to constitute the margin of the new lip; the secondary incisions, under the jaw, coming together in a vertical direction, in which they are retained by twisted and interrupted sutures.[1]

These operations are preferable to that of Chopart, who made an incision on each side of the tumor, vertically downwards over the lower jaw, according to the magnitude of the operation, even down to a level with the os hyoides. This quadrilateral flap is dissected off the bone, in its entire thickness; the parts morbidly altered are cut away by a transverse incision. The remaining portion of the flap is then raised to the proper level of the mouth, where it is retained by suture; the head at the same time being depressed, to diminish tension.

Restoration of the upper lip.—Plastic operations to restore loss of substance in the upper lip are rarely necessary; one, and perhaps the chief reason being, that cancer is so extremely rare in this situation that few surgeons have ever been here called upon to deal with its effects. With care a considerable amount of integument can be obtained from the cheeks, and united, as in the case of the lower lip, by sutures in the mesial line. The front teeth will thus obtain a covering and be protected from the cold, and the expression of the face will be much improved.

Fig. 876.



Restoration of the upper lip.

The first operation is that proposed by Von Ammon, who describes a shrinking of the upper lip, sometimes caused by prolonged salivation, by which the part is tightly stretched over the arch of the teeth, and sometimes adherent to the gums. This condition Von Ammon rectifies in the following way.[1]

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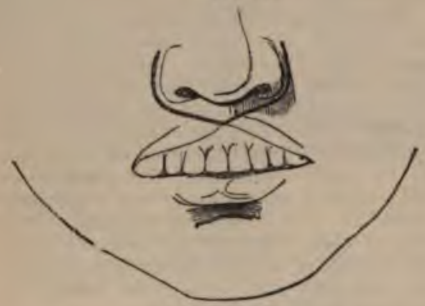
[1] Edin. Monthly Journal, 1847.

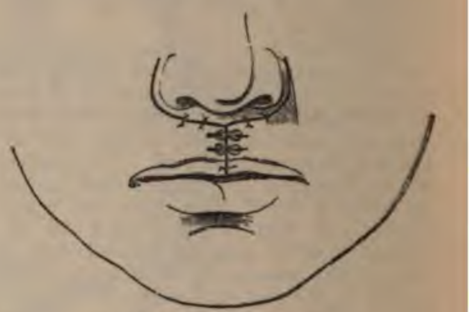
The lip is first freed by a scalpel from the gum. Then an incision (Fig. 876), A, B, is carried upwards from the angle of the mouth, for about an inch and a half, towards the alæ nasi. The tense parts separate, and this longitudinal fissure becomes triangular in form, A B C. A flap of integument is then dissected from the cheek, B D E, and is brought down to fill up the space at the angle of the mouth. After the operation has been completed on one side of the mouth, it is to be performed on the opposite.

Fig. 877.



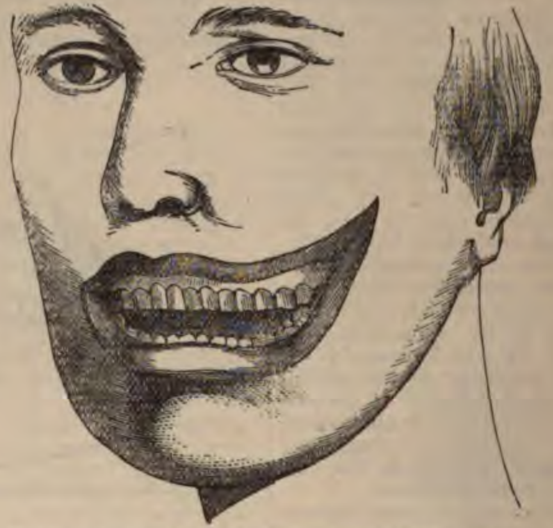
Formation of flaps for restoration of upper lip.

Fig. 878.



Flaps sutured in place.

Fig. 879.



Fissure of the lips, after Langenbeck. (From Larcher. Op. cit.)

I have no personal experience of this operation. When the central part of the upper lip is destroyed (figs. 877–878), the two side portions become drawn up towards the septum and alæ nasi, and the incisor teeth are completely exposed. Dieffenbach rectified this deformity by bringing a sufficient amount of integument from the adjacent substance of the cheeks on either side. He carried an incision by the side of the alæ nasi, down through the red of the lip; he loosened each half, and, bringing them together in the mesial line, united them by hare-lip pins and sutures.

A few cases of congenital extension of the fissure of the mouth into the substance of the cheek have been recorded by Sir W. Fergusson, by Von Ammon, and by Langenbeck. In Sir W. Fergusson's case, described under the head of macrostoma, the fissure extended so far backwards as to leave exposed the back teeth. In Von Ammon's case the fissure extended to the angle of the eye. Relief was afforded by operation.

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[1] Ammon und Baumgarten, Plastische Chirurgie, p. 155.

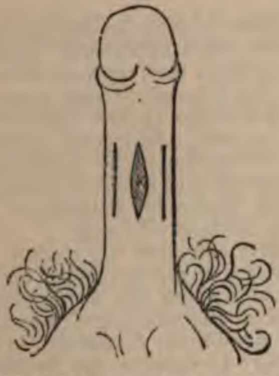
Plastic Operations on the Ear.

Defects of the external ear attract so little attention, and are in general so easily concealed by the hair, that plastic operations are rarely required. I have removed considerable portions of the pinna for warty and carcinomatous growths, and find that the wound heals best, and with less deformity than might be expected, without sutures or any dressing beside a piece of wet lint. Dieffenbach, however, has replaced a piece of the pinna removed by the stroke of a sword; but he took the flap from the adjacent region of the scalp, a part which surgeons are for the most part slow to touch. Having pared the edge of the ear, he made an incision of parallel length and about the same level through the adjacent scalp; from either end of this incision, two short cuts were extended upwards. After hemorrhage had ceased, the raw edge of the ear was united by suture to the corresponding edge of the scalp. Oiled lint was inserted underneath. At the expiration of three weeks, union being perfect between ear and scalp, the portion of requisite size was completely detached from the latter situation. It is said that the transplanted portion first became blanched, but soon regained the circulation and normal warmth. I have no personal experience in the proceeding. (See also DISEASES OF THE EAR, Vol. II., p. 171.)

Plastic Operations on the Penis.

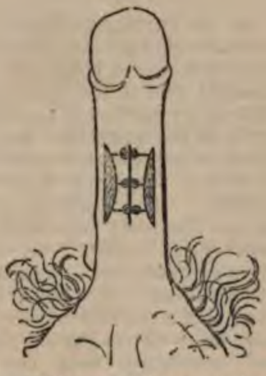
Plastic operations on the penis for deformities or imperfections, both acquired and congenital, are, as a rule, unsatisfactory in their results. Nature seems here able to effect a cure unaided by art, whenever the general conditions are favorable to recovery, or when the law of development has not been prematurely arrested. Thus fistulous passages in the urethra depend for the most part on strictures of the canal, which once properly dilated permit the ready cicatrization of the artificial opening; and congenital deficiencies in the urethral walls usually indicate an imperfect condition of the canal beyond this point, but the tube is perfect so far as it is properly formed.

Fig. 880.



Operation for penile fistula (first stage.)

Fig. 881.



Second stage of the same; the wound closed.

[One very common cause of the failure of these procedures is the impossibility of preventing the occurrence of erections of the organ, and the consequent tearing away of sutures and breaking up of adhesions. Even in cases apparently the most favorable, the most ingeniously planned and skilfully executed operation may be thus wholly defeated.]

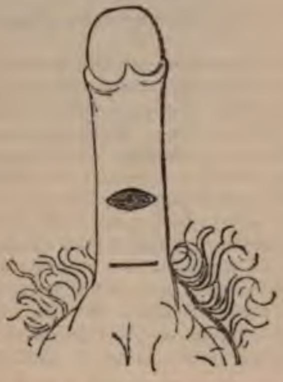
In the treatment of fistulous passages, whether near the scrotum or in the proximity of the glans, the careful employment of the catheter is the first measure necessary. The edges of the fistulous opening may after a time, if inactive, be stimulated by such remedies as tincture of cantharides or nitrate of silver; but in the early stages all such applications are useless. Cases are seen in which, after the operation of lithotomy, a long fistula communicating with the urethra remains in the perineum. Such a case I have treated successfully with galvano-cautery, *i. e.*, by introducing a piece of wire the length of the fistula, and heating it by attaching it to the circle through which the electrical stream was passing.

The simplest method of closing an opening in the urethra by a plastic operation is as follows:—

Operation.—The surgeon must dissect away a lozenge-shaped portion of integument from around the fistulous opening. He then brings the edges of the skin together with sutures; lastly, he makes a longitudinal incision on either side of the newly united wound to relieve tension (figs. 880–881). The operation is simple and easily performed, and looks well in a diagram. But there is difficulty in preventing the urine insinuating itself between the edges of the wound, causing the parts to reopen, or even leading to mortification of the flap.

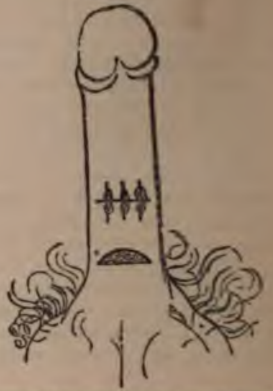
The same remark applies to a similar operation in which the incision is made transversely, and the flap of integument is drawn from behind (figs. 882–883). There is no difficulty in obtaining skin enough, especially towards the root of the penis.

Fig. 882.



Operation for penile fistula (first stage).

Fig. 883.



Second stage of the same; the wound closed.

In cases of still greater defect in the walls of the urethra, Dieffenbach has made transverse incisions through the integument before and behind the opening, and brought over it the intervening skin from the upper surface of the organ. But, inasmuch as the operation has not been promising in its results, I must refer the reader to that surgeon's works for matters of detail. The operation of M. Alliot[1] is perhaps the most ingenious, and has moreover been reported as successful. He circumscribes and dissects a small quadrilateral flap; and taking away from the other side a portion of skin equal to this flap, he so covers the fistula and the loss of substance, that the principal sutures are at a distance from the urine when it traverses the urethra.

The terms hypospadias and epispadias are given to two congenital anomalies of the male urethra, in which the orifice of the canal is situated more posteriorly than natural. In the first form, which is the more common, the urethra opens generally by a very little orifice on the inferior surface of the penis: in the latter, the opening is on the dorsal surface of the organ. In the cases of epispadias which have been published, the orifice of the urethra appears to have been situated very near to the pubis; in some instances the pubic bones have been imperfectly developed, and indeed have been represented by ligaments. An interesting case is recorded by Mr. Partridge (Trans. Path. Society, vol. xvi., p. 192). Additional difficulty in the way of treatment by operation proceeds from the fact that the arrest of development generally extends in some degree to the bladder itself.

M. Follin attempts the closure of the open urethra in epispadias, by first making incisions along the upper surface of the penis, at the junction of the skin and mucous membrane, dissecting on either side so as to expose a raw surface, and then bringing down from the front of the abdomen a flap of integument, which is to be accurately fitted into the open urethra. A covering of integument is next obtained at the expense of the scrotum. I have no experience of the operation. One on a similar principle, performed by M. Nélaton, is represented in fig. 884.

In the case of hypospadias surgery does not offer any favorable results. Attempts to establish a urethra in the substance of the penis by means of a fine trocar, have usually been followed by violent attacks of inflammation, and by partial gangrene, without the patient obtaining even ultimate benefit. The case is one of arrested

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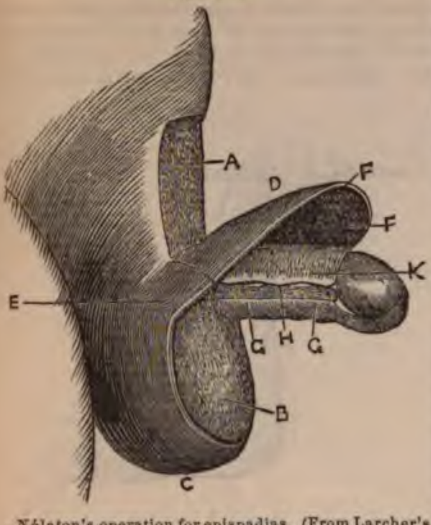
[1] Fritze, op. cit., p. 116.

Fig. 884.



Nélaton's operation for epispadias. (From Larcher's translation of "Holmes on Surgical Diseases of Children".) A, the part from which the abdominal flap has been taken. B, the part from which the scrotal flap has been taken. C, the lower part of the scrotum. D, the scrotal flap, which has been notched in the middle of its base to allow the penis to be slipped through it. E, the lateral adherent parts of the scrotal flap. F, F, the anterior border and bleeding surface of the scrotal flap. G, G, the refreshed edges of the skin of the penis. H, the raw edges of the abdominal flap. K, the bleeding surface of the abdominal flap, on which the bleeding surface of the scrotal flap is to be applied.

development, in which the construction of the parts is irremediable.

On the Treatment of Contracted Cicatrices.

Within the vagina.—The mucous membrane of the vagina is subject in infancy to a low form of inflammation, which terminates in sloughing of part or of the whole of its circumference. The separation of the slough, and subsequent cicatrization of the wound, is followed by contraction of the cicatrix, and narrowing of the vagina at a variable distance from the os externum. These later changes often escape observation until the patient attains a marriageable age, when she finds connection impossible, and the attempt extremely painful. The cicatrix, however, yields very readily; and the defect may, in many cases, be overcome immediately by the introduction of the fingers or any dilating instrument, the patient being under the influence of chloroform. But this proceeding is not unattended by danger; for if the cicatrix be rudely torn, a low form of pelvic cellulitis is set up, extending perhaps to the peritoneum, under which the patient sinks.

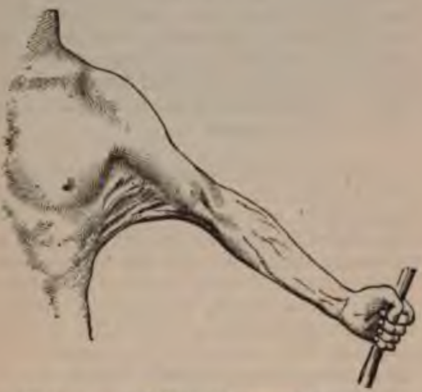
I cannot dwell too strongly on the dangers of violence in all such cases. No cutting instrument should be used; for the integrity of the walls of the vagina must be preserved, and a fresh cicatrix would, by its secondary contraction, lead only to further difficulties. No laceration by sudden violence is permissible, for inflammatory mischief may ensue therefrom. But sponge-tents should be introduced, that the contracted orifice may be slowly, cautiously, and painlessly dilated, without laceration, but with gradual absorption of that peculiar material on which the firm dense part of an old cicatrix depends.

Cicatrices from burns, escharotics, etc.—The application of heat or of powerful escharotics will either disorganize the superficial layers of the skin, or destroy its entire thickness. In the former case, cicatrization is completed without deformity; in the latter, a secondary process, that of contraction, goes on after the new material is formed over the wound; and this contraction proceeds slowly, almost imperceptibly, and painlessly, but irresistibly save by mechanical treatment, until changes as regards the limbs most serious, and as regards the face most hideous, are produced. [Figs. 885 and 886 show examples of very common and very troublesome contractions of this kind in the upper extremity.] The smooth white cicatrix drags by its contraction on the surrounding integument, pulling it into folds, and puckering it up as towards a centre. It becomes itself elevated into knobs or tubercles, which seem to grow thicker and thicker the more complete the contraction. There is no limit as to time when the patient can be pronounced free from further extension of the evil, especially among the young during the important period of growth. No tissue is exempt from its influence, and even the bones undergo an alteration in form. In cases of severe burns about the neck, the chin is drawn down, the alveolar border of the jaw and the front teeth are everted, the nose is dragged to one side, the lower eyelid turned outwards, and, when the burn has affected one side more than the other, the whole bony framework of the corresponding side of the face has exhibited the marks of the contracting force. [Fig. 887.]

Surgical ingenuity has been pushed to the uttermost to devise operations by which this distressing calamity may be removed; but I express the opinion of most surgeons of experience of the present day, in affirming that hitherto almost all such operations have proved failures; and for this simple reason, that whenever an incision is made, a new cicatrix must be formed, and this new cicatrix will undergo precisely the same process of contraction as the former, which it was intended to alleviate.

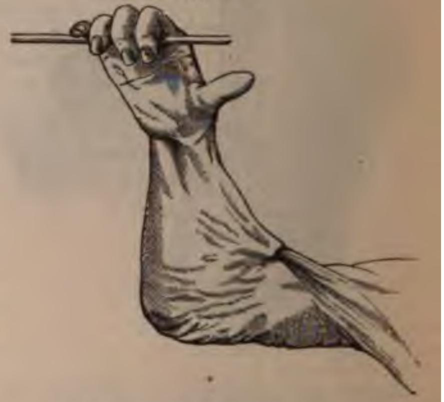
It may be laid down as a rule almost without exception, *that a cicatrix should rarely be touched with a knife.*

[Fig. 885.



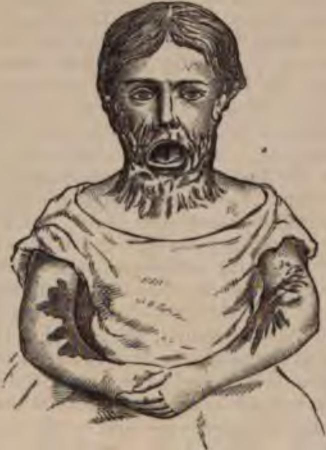
Contraction of adhesions between the arm and the side.

Fig. 886.



Contraction of elbow from cicatrix of burn of fourth degree.]

Fig. 887.



Contraction of cicatrices after burns.

The late Mr. Earle proposed to cut away the whole of the cicatrix, and then bring the edges of the healthy skin as much towards each other as possible, in the transverse direction, with strips of adhesive plaster. But in most cases this measure is impracticable, either from the situation of the burn, or from the amount of integument already destroyed. Who, for instance, could dissect away a large cicatrix from the front of the neck, and drag forward the skin from the sides and nape by means of strips of adhesive plaster passing over the larynx and trachea? The practice of detaching and transplanting a flap of integument has been recently revived by Mr. Teale, of Leeds. But to this proceeding I would quote the words of Mr. Skey: "There is no difficulty in obtaining sound skin by autoplasm to supply the deficiency and to fill up the space caused by the division of the bridles; but the real difficulty consists in effecting its junction with the diseased parts, and in retaining its vitality, for the base of the wound so made is not to be deemed healthy, but, on the contrary, is greatly indisposed to co-operate with the skin laid down and to accept its union. It would appear that the vital force of this structure is too much exhausted in the struggle against the necessary agents of extension to participate in the healthy actions requisite for adhesion to the structure brought into apposition with it; and when we consider the adventitious nature of this tissue, and the probable condition of its vessels, the failure of these operations is not surprising; but this failure is by no means necessary or universal."[1] Mr. Skey has proposed to obtain extension of the cicatrix by means of a number of minute divisions both of the skin and subjacent tissue, founding his practice on what may be deemed, he says, an axiom in surgery, viz., *that the contraction of wounds is slight in proportion as the time consumed in the healing process is short.*[2] But even in this practice the secondary contraction inseparably connected with a newly-formed cicatrix cannot be avoided; and I therefore would direct especial attention to the method of treating these cases by mechanical extension alone.

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[1] Operative Surgery, p. 687.

[2] Op. cit., p. 688.

When gentle yet constant traction is exerted on a hard and contracted cicatrix, it yields, without tearing, with singular facility; the hard knots disappear, the firm seams become soft and pliant, and the new skin regains the suppleness, though not the completeness, of the natural structure. After extension has been kept up a sufficient length of time, the material on which the contracting power depends becomes absorbed, and the elongation of the cicatrix is permanent.

The results of this treatment are mostly satisfactory, and failure proceeds from want of patience, which substitutes forcible, and as it were spasmodic, efforts, for persevering and unremitting gentleness.

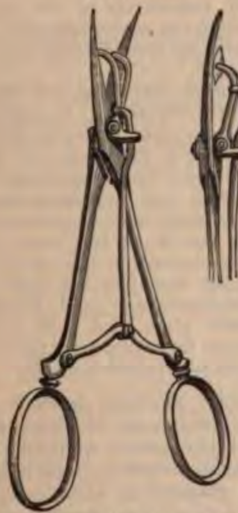
To the objection that the system is tedious, I would reply, what can be more wearisome than the attempt to heal a large open sore following a divided cicatrix? The principle in all apparatus for such cases consists in slow extension, effected usually by means of the cogwheel. For the extension of a cicatrix in the neck we employ a pelvic band of steel, with two side crutches and a webbing-band in front to keep the instrument steady; a posterior steel upright, to which is attached a headpiece with branches, movable in every direction by means of cogwheels and a strap under the chin. Every day, or every other day, the smallest possible amount of extension must be made and maintained; but the patient should suffer no pain, nor must the skin be allowed to break. If a sore should form, the apparatus requires removal, and the advantages thus far obtained will be lost during the tedious cicatrization.

The same remarks apply to the extension of the cicatrix of a contracted limb. The apparatus, modified according to circumstances, must be worked by a cogwheel, which ensures steady, unremitting, and yet limited exercise of force. The hardened seams elongate and become soft, and the freedom of movement is regained far more speedily, effectually, and painlessly, than by any other means.

In slighter cases a great amount of benefit will ensue from direct pressure; a piece of vulcanized India-rubber is moulded exactly to the contracted part, and is retained there by a bandage, strap, or elastic roller. In the course of a few weeks the hardened seams become softer, and the integument regains its lost pliancy. This practice is useful in cases of contraction of the elbow in children; also in the treatment of contractions of the neck, especially in combination with the extending apparatus, when the chin seems lost in the deformity, and the teeth are assuming a horizontal direction.

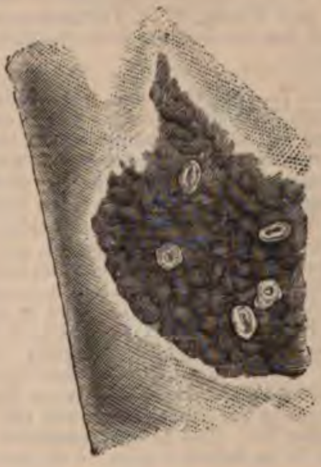
Transplantation of skin.—All surgeons are familiar with the cases of large open chronic ulcers on the lower extremities of the working classes; with the extensive granulating surfaces which are the consequence of burns; with the vast denuded wounds, which follow machinery accidents. The loss of skin constitutes the most important feature of the case, for it seems to paralyze all efforts at repair, and in many cases amputation or other operations have been undertaken,

[Fig. 888.



Scissors for skin-grafting.]

[Fig. 889.



A sore with grafts of skin beginning to spread (Bryant).]

upon the conviction that no reasonable hope could be entertained of the accomplishment of cicatrization.

In the early part of 1870, a paragraph appeared in the daily papers, containing some severe remarks on an operation for transplanting skin upon open wounds as performed by a "Hospital Surgeon," who proved to be Mr. Pollock, of St. George's. The ingenuity and merit of the invention, which is due to M. Reverdin, of Paris, the readiness of adoption, which is due to Mr. Pollock, and the great success which has followed the numerous trials and experiments now made in every direction, warrant the conclusion that the proceeding is one of the most striking and successful in modern surgery. The proceeding is simple: several minute pieces of skin, about the size of a millet-seed, and in number according to the size of the open sore, are taken from the thigh or from some other convenient part of the same individual; they are then carefully introduced under the granulations and maintained there by plaster. In the course of a few days each point of detached and transplanted skin becomes the centre of cicatrization, which spread one towards the other, or towards the circumference of the sore. First was noticed a slight bluish ring, which, in a few hours acquired in every instance the character of a thin cicatrix. So simple and so beneficial was this operation found, that in St. Bartholomew's, and I hear also in other hospitals, the house-surgeons have adopted it as a common method of treatment. Mr. Young, of St. Bartholomew's Hospital, has favored me with the following case:—

William T., aged sixty-one, was admitted October 27, 1870, with a large chronic ulcer of the left leg, nearly surrounding the limb, and of twenty-five years' duration. There was a smaller ulcer of the right leg of two years' duration. On November 4, Mr. Young planted four pieces of skin from the thigh on the ulcer, simply laying them on the granulations and covering each of them first with a small piece of oiled lint. The whole ulcer was then covered with lint soaked in zinc lotion; it was supported by a roller. On November 20, seven additional pieces were planted. On November 30, three more pieces were planted; December 3, one larger piece was planted in the centre of the same leg.

December 16. The present condition of the limb is as follows: Most of the transplanted pieces have become adherent. Those planted six weeks ago have spread to the size of a florin piece. Those planted on November 20 are now about the size of a shilling. Lastly, those of a fortnight's duration are about the size of a three-penny-piece. But besides this, the whole ulcer, which had been for so many years and under all circumstances stationary, has become contracted to about half its original size. One piece of transplanted skin situated near the edge of the ulcer was noticed to spread until the two finally coalesced. The case terminated most satisfactorily.

It was observed, with reference to the larger portion of transplanted skin, that a natural effort was required for the maintenance of its vitality; the cuticle separated, some of the deeper structures seemed to slough, and its adhesion to the granulating surface was incomplete and often unsatisfactory. Indeed, it seemed as if the smaller the piece of transplanted skin, the more satisfactory was the process; and thus the inference was drawn, that if a bit of skin were cut off and chopped into minute bits on the thumb-nail, and these pieces were strewed broadcast over the ulcer, union would take place as usual with less trouble and with a more rapid result.

The following case is also instructive. Charles G., aged forty, had a large chronic ulcer commencing about two inches above the malleoli on the front and internal surface of the leg, and extending nearly six inches upwards, with the average width of three to four inches, well defined and somewhat irregular. The whole was of two to three years' duration. He was admitted October 12, 1870. October 22, four pieces of skin about the size of a grain of wheat, taken from the thigh, were transplanted by myself, the whole limb being afterwards covered by wet lint and a bandage. October 28 the lint was removed; three of the pieces were adherent, and there was an increase of vascularity in the granulations surrounding the transplantation. The case ended well; the wound being completely closed.

Mr. Cumberbatch performed the following experiment. On Saturday, December 17, 1870, an arm was amputated at St. Bartholomew's Hospital at 2 P. M.; at 6 P. M. Mr. Cumberbatch entered the theatre, four hours after the operation, and took from the limb, which was then quite cold, a portion of integument. He cut it up into small pieces, which he transplanted in the usual way. After bandaging the part he opened the wound on the fourth day, and found that union had taken place, and that cicatrization was going on favorably from the various points; the case terminated favorably.

In the Gazette Médicale de Paris, 1870, there is a proposal from M. Marc Sée to substitute for the above method simple epidermic transplantation. Sufficient time has not yet elapsed to allow a definite opinion to be formed from the experiments now being conducted in reference to this point.[1] [Further experience has established this as a surgical procedure.]

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[1] The proposal to substitute the lining membrane of a fresh egg in place of the living tissue has not merited further remark, except that it differs in no respect from covering an open wound with goldbeaters' skin.

MINOR SURGERY.

By Thomas Smith, Esq.

Revised by John H. Packard, M.D.

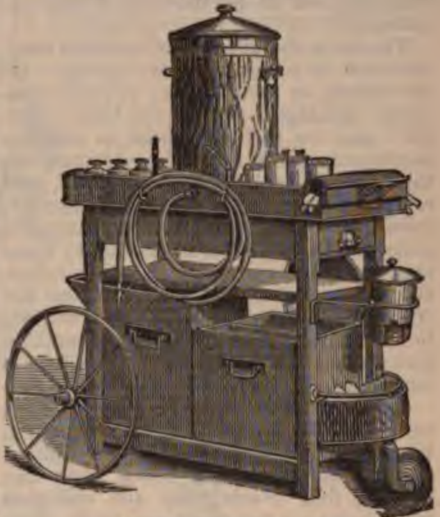
The following essay is not intended to embrace all matters usually included under the term "Minor Surgery," since many of these will be found scattered through this work, being treated of under the special diseases or particular localities with which they are more immediately connected. Nor does it attempt to enter into the minute details found in systematic works on minor surgery; but its aim is to describe briefly such proceedings in that branch of surgery as are for the most part general in their application to the several regions of the body, and are used in the treatment of many and various diseases.

[Certain instruments, which are in constant use in surgical practice, or liable to be needed, are carried in what is called the "pocket-case." Of this there are very various forms. The old fashioned ones contained a great many instruments; but the more modern are carefully planned with a view to economy of space and to lightness.

The simpler these cases are the better; it is not worth while to load them up with appliances which will only seldom be called for. We may mention as essential: A scalpel, a bistoury, scissors, forceps, probes, director, porte-caustic, tenaculum, catheter (male and female combined), needles, silk, suture-wire, ligatures. Some surgeons carry several bistouries, straight, curved, and probe-pointed, saving space by having two put in a double handle. When this is done, both ought always to be carefully cleaned when either one has been used.

In hospital practice, an apparatus known as the "ward-carriage," introduced several years ago by Dr. T. G. Morton, of this city, will be found very useful. As its name implies, it is on wheels, and the object of it is to carry easily all the appliances likely to be needed by the surgeons on their rounds. One very valuable feature of it is a tank, with a rubber hose, by means of which water may be directed in a stream upon wounds, etc., thus largely doing away with the use of sponges and basins. The wheels are fitted with rubber tires, to deaden the noise (fig. 890).

Fig. 890.



Morton's ward carriage.]

Bandages, and their Application.

Bandages are appliances adapted, according to circumstances, to maintain uniform pressure on subjacent parts, to retain in position fractured or dislocated limbs, to assist in maintaining contact between the edges of large wounds, or to aid in the application of topical remedies to various parts of the body. For ordinary purposes they are made of linen or calico; in particular instances flannel, or some other elastic material, is employed, being torn into strips of appropriate length and width, and prepared for application by rolling up: these pass under the conventional name of rollers. [Unbleached muslin is by far the best material for ordinary surgical use. The selvedges should be carefully torn off, and if it is necessary to sew together several pieces, the seams should be made very smooth, and laid so as not to irritate the skin. Bandages should be of width proportioned to the size of the part concerned; if too wide they cannot be nicely applied; if too narrow they are easily displaced. Usually between two and three inches is a suitable width.] Rollers may be single-headed, where the bandage is rolled up from one end alone, the other remaining free; or double-headed, where both ends of the bandage are rolled up each into a separate coil towards its centre. [At the present day the latter are very rarely used.]

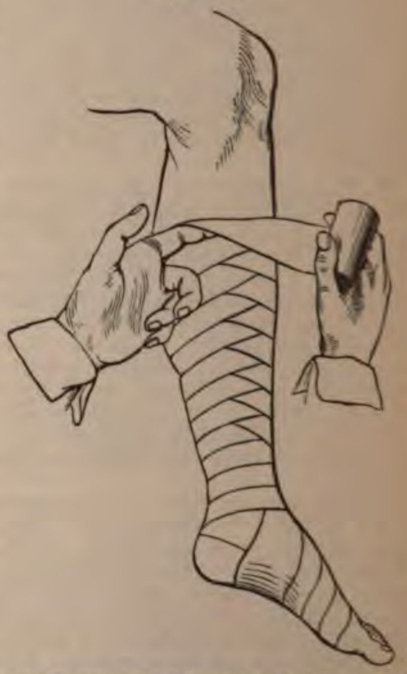
To meet the varying requirements of various parts of the body, and to fulfil the diverse conditions for which they may be needed, ingenuity has devised a most extensive variety in the construction of bandages and in the manner of their application.

The more useful forms of bandage may, however, be included in two groups: (1) the simple or continuous; (2) the compound bandages. Under the term "simple" may be included those in which a continuous roller is employed; these are the circular, spiral, figure-of-eight, and scalp bandage. Compound bandages are such as require more than a continuous roller for their proper adjustment; these may be enumerated as the many-tailed, the four-tailed, the suspensory, and the T-bandage, besides others which will not here be referred to, as their preparation and application belong to the province of the instrument-maker or bandagist.

Of simple bandages, by far the most useful and most general in its application is the spiral. It consists in a continuous spiral application of a roller, each succeeding fold overlapping the one that went before it by about one-third of its width; it is used on the fingers, the upper and lower extremities, the thorax, and abdomen. This form of bandage is in all cases applied from below upwards, or from the extremities towards the trunk. So long as the part to which it is applied is of uniform calibre, as the forearm for a short distance above the wrist, the bandage may be simply rolled around the limb, passing from left to right as it crosses the anterior aspect; but if the circumference of the limb gradually increase in size from below upwards, as the calf of the leg or the upper part of the forearm, the bandage must be folded on itself [or *reversed*] in the manner represented in fig. 891. This proceeding should be effected at each turn of the roller, and should always take place opposite the same point in the circumference of the limb, or an unsightly appearance will be produced. Its effect is to distribute the pressure evenly over the surface of the part, and to obviate the risk of the bandage slipping. By referring to the woodcut on the next page (fig. 892), it may be seen at what parts of the body it is generally necessary to turn the bandage in the manner above mentioned.

The spiral bandage is not well suited for passing smoothly over the angles of flexion or extension of joints, and for this reason the other variety of simple bandage, the figure-of-eight, is employed in conjunction with it in bandaging certain parts of the body. Thus to bandage the lower extremity, taking the head of the roller in the right hand and its free end in the left, the outside of this end should be laid on the dorsum of the foot and fixed by a turn or two of the roller. Passing over the limb from left to right, carefully keeping the bandage in a uniform state of tension, with as little of it unwound as possible, it may be now applied in a simple spiral manner, the roller changing hands each time it passes around the foot. The enlargement at the instep requires that the bandage be twisted on itself; over the ankle-joint it must be applied in a figure-of-eight fashion; again, at the lower part of the leg, it may be simply rolled around the limb, and higher up it must again be twisted on itself; and so on, varying in its method of application with the varying conformation of the part (fig. 891). It may be fastened off by pinning its end to the last fold applied; or the end may be split into two, and these, being carried in opposite directions around the limb, may be tied together where they meet.

Fig. 891.

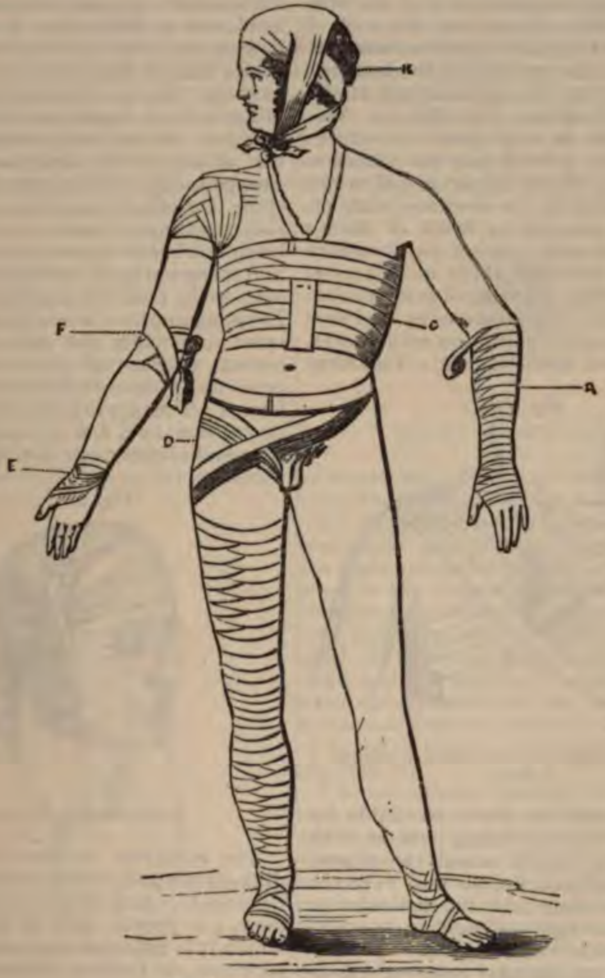


Mode of applying the roller by circular and reversed turns.

The peculiar shape of the thorax, increasing as it does in circumference from below upwards, requires that a roller applied to that part, commencing from below, should be turned on itself as it ascends. Before applying a bandage to the thorax, a wide piece of roller, about five feet in length, should be split lengthways from its centre for about half a yard; this being thrown over the head of the patient, the ends may be allowed to hang down in front and behind. The patient standing with his back towards the surgeon, his hands raised above his head and resting against some support, the bandage may be applied over the neck-piece, beginning from below. It may be finally fastened off and secured from slipping in the manner represented in fig. 892, C.

The figure-of-eight bandage is formed of a single continuous roller, and is admirably adapted for passing over the angles of the joints; and here indeed it is almost exclusively employed: as at the ankle, the knee, the groin, over the metacarpal articulation of the thumb or finger, over the elbow-joint and shoulder. Again, it is made use of to keep the shoulders apart, or to draw them together, according as it crosses in front or behind the body. At the ankle the crossing of the bandage is so arranged as to fall in front of the ankle-joint, while the two circles of the figure embrace respectively the leg and foot (fig. 892). At the groin the two circles of the figure should surround, the one the upper part of the thigh, the other the pelvis; this form of bandage, under the name of

Fig. 892.



Application of various bandages.

spica, is generally applied after operations for strangulated hernia, the crossing of the roller being arranged so as to fall over the situation of the internal abdominal or femoral ring (fig. 892, D). In applying the figure-of-eight to the thumb, one limb of the figure should surround the root of the thumb, while the other passes around the wrist, the crossing of the bandage being situated over the subcutaneous margin of the metacarpal bone (fig. 892, E). At the elbow this form of bandage embraces the upper arm and forearm, and crossing over the flexure of the joint is thus made available for compressing the orifice of the vein after venesection as ordinarily performed (fig. 892, F). In bandaging the shoulder, the roller is passed around the upper part of the arm on the one side, and around the root of the neck, or under the opposite shoulder, on the other; the crossing of the bandage will thus lie over the prominence of the head of the humerus (fig. 892, G). The figure-of-eight, as employed for fractures of the clavicle, crosses over the situation of the spines of the upper dorsal vertebræ, and surrounds the shoulder-joints on either side, passing in front of them; when it is desirable to bring the shoulders forward and maintain them in this position, the bandage is arranged so as to cross over the front of the sternum and surround the shoulder-joints on either side, passing behind them (fig. 893). This form of bandage may be made available for compressing or supporting one or both breasts, being passed round the thorax under the affected breast and over the opposite shoulder. At the articulation of the knee the figure-of-eight is occasionally employed to bring together the fragments of the patella after transverse fracture of that bone; for this purpose the circles of the figure must the one surround the leg, the other the thigh, the bandage being crossed in the popliteal space. For other purposes the bandage is reversed, and so applied that the crossing falls over the front of the articulation.

Fig. 893.

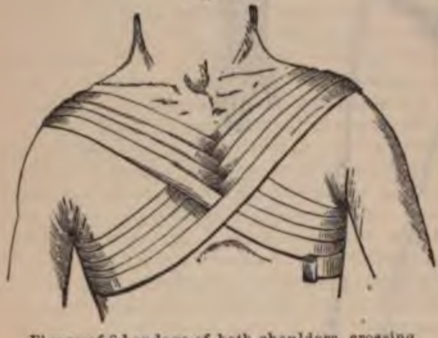
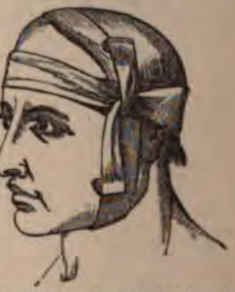


Figure-of-8 bandage of both shoulders, crossing in front.

Of *scalp-bandages* there are two principal varieties—the knotted and the recurrent; they are employed for retaining local applications to wounds of the scalp, or for exercising pressure on the part to control hemorrhage. The knotted bandage, which is generally employed for compressing the temporal artery, is applied in the following manner. A bandage, about two inches in width and four yards in length, being rolled up at either end into two separate and unequal portions, the surgeon taking one head of the roller in each hand, and standing facing the wounded artery, applies the unwound portion of the bandage over the compress. He should now pass his hands around the head, one on either side, so as to encircle it with the roller until he reaches the opposite temple, when the two heads of the bandage being crossed, they may be brought back again to the point of departure. Here, being crossed one over the other, their direction should be changed, one end being carried under the chin, the other over the vertex, so that they may again meet over the opposite temple, where they are again to be crossed and carried around the head, one on either side, to the point whence they first started. Here, again, they are crossed, carried respectively under the chin and over the vertex, and so on until sufficient compression is exercised over the wounded vessel. The application may be secured in position by a few circular turns of the long end of the roller (fig. 894).

Fig. 894.



Knotted bandage of the head.

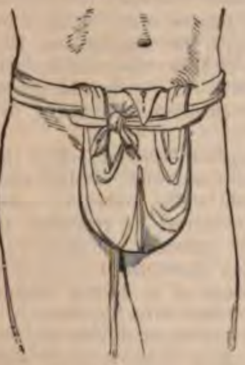
The recurrent or capeline bandage is difficult of application, and easily becomes displaced. As it is almost impossible to convey a proper idea of the manner in which it is adjusted by a mere verbal description, no further allusion will here be made to it.

Compound bandages.—The **T**-bandage, the four-tailed, the many-tailed, and the suspensory bandage, fall under this denomination. The T-bandage is formed of two pieces of linen roller attached to each other in the manner indicated by the name of the application. It is principally used in the neighborhood of the perineum, where it is well adapted to maintain pressure on the parts, or to retain in position any topical application.

In applying the bandage, that part of it represented by the horizontal limb of the T being passed around the body just above the crests of the ilia, should be fixed by tying together the ends in front of the belly, in such a position that the vertical part of the bandage shall be situated over the spines of the lumbar vertebræ; if the application is to be adjusted to a female, the loose end may now be brought forward between the nates and in front of the vulva, and attached to the horizontal portion in the median line of the abdomen. If the patient is of the opposite sex, the vertical part of the bandage should be split at its free end, and the two ends brought up one on either side the scrotum and penis to be attached to the part of the bandage that encircles the body. As a ready and efficient substitute for the linen roller, two pocket-handkerchiefs may be used in the application of this form of bandage.

Suspensory bandages are to be procured ready for use of an instrument-maker, though occasionally they must be improvised by the surgeon; for such an emergency, a handkerchief or a piece of bandage being tied around the abdomen just above the crests of the ilia, a second handkerchief should be passed beneath the scrotum, and attached in the manner represented in figure 895.

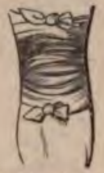
Fig. 895.



Handkerchief suspensory.

The *four-tailed bandage* is made by taking a piece of linen about six inches wide and a yard and a half long, and splitting it up the middle from either end to within three or four inches of the centre; this would form such a bandage as might be applied over the knee; but of course the size of the apparatus must be regulated by that of the part of the body to which it is to be adapted. The form of bandage under consideration is generally employed for maintaining in position topical applications, but is occasionally made use of to secure the correct apposition of fractures; it is applied over the knee-joint, to the lower jaw, and on the vertex. To adjust this bandage to the knee-joint, the centre of it should be placed on the patella, the four tails, being passed around and under the knee and crossed behind the limb, should be brought forward again, the lower pair being tied together in front of the thigh above the patella, the upper pair over the head of the tibia on the anterior aspect of the leg. For the lower jaw the bandage should not be more than three or four inches in width, and a hole should be cut in its centre to admit the prominence of the chin; in adjusting it, the centre of the bandage should be placed under the chin, and the tails being carried upwards, the hindermost pair should be tied over the vertex about the situation of the coronal suture, while the anterior pair of ends are taken backwards and fastened together above the occipital protuberance. When applied to the vertex, the bandage should be wider than that required for the chin; its centre being placed on the vault of the skull, the posterior tails should be brought down and tied together beneath the chin, while the anterior pair are carried backwards and fastened beneath the occiput, or brought round again under the chin (fig. 892, K).

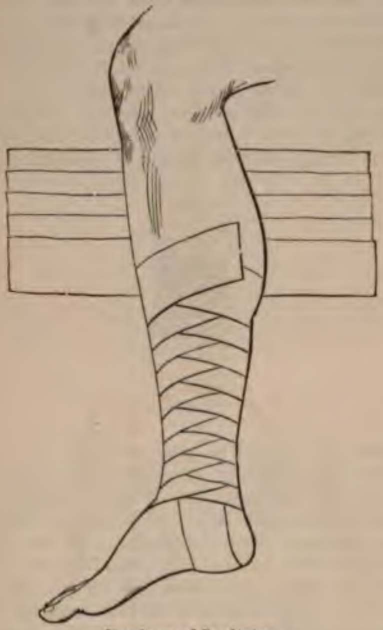
Fig. 896.



Four-tailed bandage applied.

The *many-tailed bandage*.—The advantage of this form of application is, that it can be applied and removed without any disturbance of the parts to which it is adjusted; and thus it is chiefly used in the treatment of compound fractures, in the dressing of stumps after amputation, or in any case where absolute quietude is desirable. The bandage is constructed in the following manner: to a wide piece of roller, rather longer than the part of the limb to which the bandage is to be applied, should be stitched in succession several shorter portions of a narrower bandage; these should be attached by their centres in such a manner that each piece is at right angles to the long roller, and overlaps the preceding piece by one-third of its width. These shorter portions should be each about half as long again as the circumference of the limb they are to surround. This bandage, like the spiral, should be applied from below upwards; the back piece should be drawn up behind the limb or part which is to be bandaged, and the transverse portions spread out evenly on either side, the last piece sewn on standing first in order for application. Beginning from below, the opposite ends of these transverse pieces should be crossed over each other around the limb, each succeeding pair overlapping and keeping in place the ends of bandage that immediately preceded them (fig. 897): the last pair may be tied together, or kept in position with a pin.

Fig. 897.



Bandage of Scultetus.

IMMOVABLE APPARATUS.

Under this head it is proposed to consider those methods of bandaging by which support and immobility are secured; the essential principle of the application being that it admits of adaptation while in a moist and pliant condition, and is thus enabled the more exactly to accommodate itself to the conformation of the parts to which it is applied, before assuming its permanent condition of immobility.

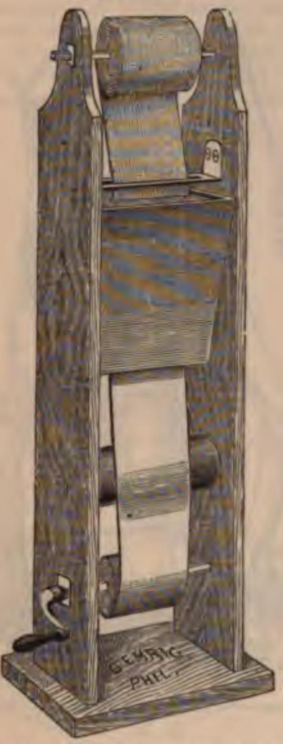
Gum-and-chalk, white-of-egg and flour, gypsum, starch, dextrine, leather, gutta-percha, millboard, pasteboard, Hide's felt, are any of them made use of in combination with the ordinary bandage for the above-named purpose. These forms of immovable apparatus are employed in the treatment of fractures, in chronic joint-affections, and other diseases where it is necessary to maintain permanent immobility or pressure.

Gum-and-chalk is prepared by rubbing together in a mortar mucilage with a sufficient amount of chalk to form a mixture about the consistence of thick cream. The limb being placed in the position in which it is desirable it should be retained, should be protected over its more prominent points with a layer of cotton-wool. Having been firmly and evenly bandaged, the gum-and-chalk may be smeared over the roller with a brush or the open palm of the hand; in doing this the hand or the brush should be applied to the part in the same direction as the spiral of the roller, that is, around the front of the limb, from left to right. If a great amount of rigidity is required, a second bandage may be applied, and treated in the same manner; or the apparatus may be still further strengthened by combining with the bandage gutta-percha, leather, or pasteboard splints moulded to the parts while in a pliant condition. These should be applied to the limb immediately over the cotton-wool sheathing, and they may be retained in position during the application of the first bandage by strips of adhesive plaster. The gum-and-chalk bandage takes from four to five hours to dry, and during this time, if there is any considerable tendency to displacement in the limb, means must be used to counteract it until the application has become rigid. For this reason it is that the plaster-of-Paris, or gypsum bandage, as it is called, is preferred by many to the gum-and-chalk.

The gypsum bandage.—For this form of application a roller, which should be of coarse and open material, must be previously prepared by rubbing into its texture dry powder of plaster of Paris. [The most convenient way of doing this is by means of a double bandage roller such as is shown in fig. 898.

The loose-meshed muslin, cut or torn from the piece of the desired width, is first rolled on the upper rod, and the loose end carried down through a very narrow slit in the bottom of the trough below. Into this trough the finely-ground dry plaster is sifted, while the bandage is slowly rolled downwards, round the lower bar, which is just like that of an ordinary bandage-roller.] The surgeon should have at hand a bag of the same material, and a basin of water. The limb being protected with a layer of cotton-wool, the prepared roller should be immersed in water for about a minute; it is then ready for immediate application. It should be rolled around the limb in a spiral manner, just as an ordinary bandage; after every second or third turn of the roller, the left hand should be plunged into water and smeared over the part last applied. [Generally it is necessary, in order to form a casing of sufficient firmness, to apply several such rollers, one above the other.] When the whole has been thus treated, the exterior of the bandage should be rubbed over with a paste of plaster-of-Paris and water, until a smooth surface and sufficient rigidity have been attained. This form of application, after the lapse of ten minutes or a quarter of an hour, will have acquired its permanent condition of rigidity.

[Fig. 898.



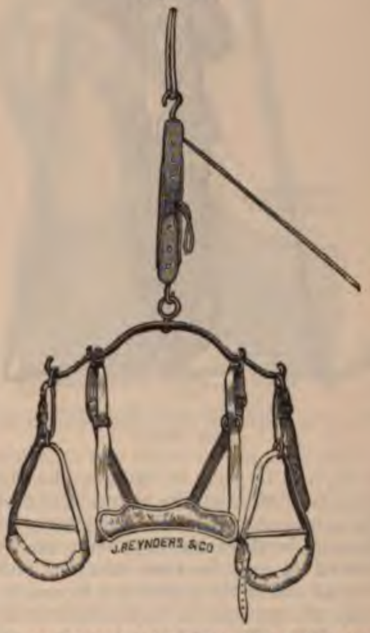
Double bandage roller for preparing the plaster-of-Paris bandage.]

[Within the last few years the method of treating spinal curvature by means of plaster-of-Paris jackets has been brought prominently forward by Dr. L. A. Sayre, of New York, and used with great success by him and other surgeons. A brief description of the mode of applying it in these cases may be appropriately introduced here.

The bandages, of suitable width according to the size of the patient, and from three to six yards long, are prepared in the way already mentioned. Narrow strips of roughened tin are provided, to be placed longitudinally (across the turns of the bandage) so as strengthen the apparatus while lessening the weight of plaster required. The patient's chest is stripped, and a very close-fitting woven shirt applied next the skin.

As it is difficult for an assistant to hold the patient suspended during the time required for the application and hardening of the dressing, the apparatus shown in fig. 899 has been devised. It consists of a curved iron cross-bar to which are attached an adjustable head- and chin-collar and axillary bands. To a hook in the centre is attached a compound pulley, the other end of which is secured either to a hook in the ceiling, or to the top of a tripod about eight feet high, fig. 900.

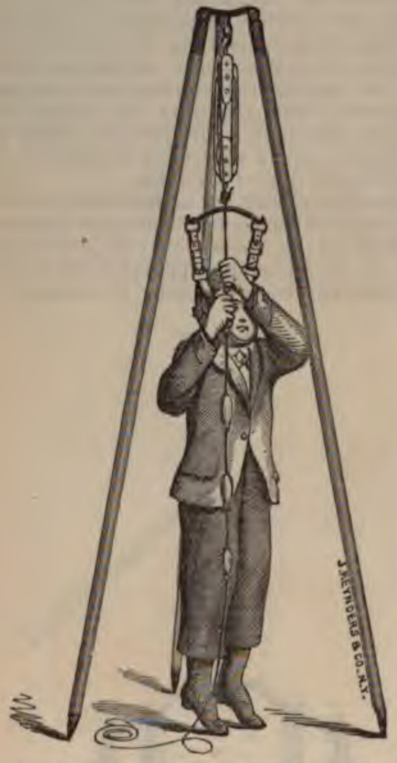
Fig. 899.



Suspensory apparatus for application of the plaster jacket.

The collar and bands having been carefully adjusted, the patient is drawn up until the feet are clear of the floor, and a wedge-shaped "dinner-pad," the thin edge downwards, is fitted over the epigastrium. This pad is made of raw cotton folded in a handkerchief, and is intended to prevent the plaster jacket from being too tight to allow of distension by food taken into the stomach. Small pads of cotton are also placed over all bony prominences, and in girls or women, the mammæ are protected in like manner, the pads to be removed just before the plaster sets.

Fig. 900.

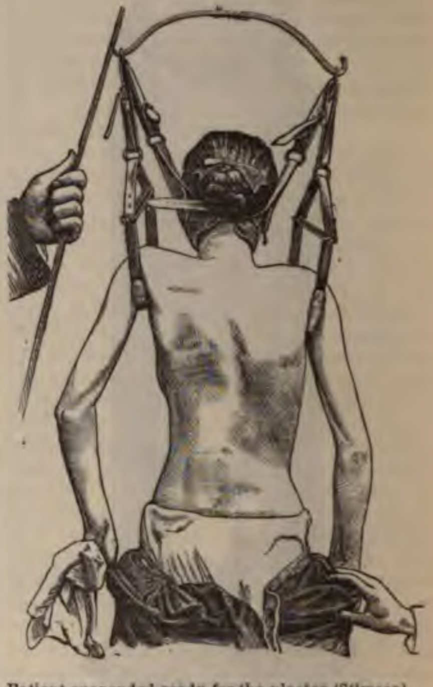

J. REYNDERS & CO. N.Y.

Tripod for suspension during application of the plaster jacket.

The undershirt having been carefully adjusted (it may be tied over the shoulders and under the perineum by means of tapes), the patient is kept suspended, as in fig. 901, while the bandage is applied over the shirt, around the smallest part of the body first, then down to the upper part of the pelvis, and then spirally until it encases the whole of the trunk, smoothly but not tightly. When one or two layers of bandage have been put on, the strips of tin are added, and then another layer of bandage. As soon as the plaster is firm enough, the patient is carefully lowered and laid on his back on a firm mattress. All the pads that can be reached are removed, and the jacket carefully and gently dented in with the hand in front of each iliac spine. Any weak spots may be wetted, and a little more plaster dusted on.

There are other mechanical arrangements used by some surgeons instead of the tripod; an English method is to lay the patient in a hammock, face downwards, and after applying the plaster and placing the patient on the mattress, to cut away the hammock at the upper and lower edges of the jacket. By some, the bandages are first arranged in order (as in the so-called "bandage of Scultetus") on a mattress, and the patient laid upon them, when they are brought up around him and secured. Some surgeons dispense with the dinner-pad by making the patient eat a hearty meal just before beginning the operation.

Fig. 901.



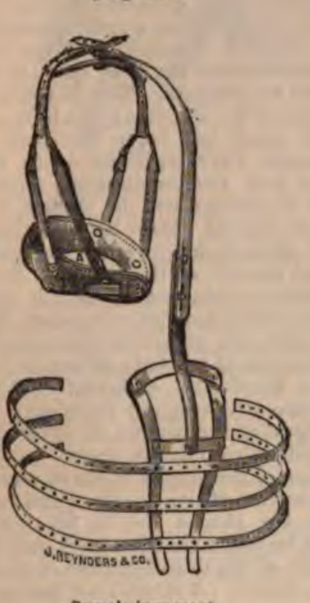
Patient suspended ready for the plaster (Stimson).

Any existing sores or sinuses should be covered, previous to the application of the jacket, with a large piece of oiled silk or fine rubber-cloth. Before the plaster hardens, a hole is cut in it, and the oiled silk cut in radiating lines from the centre to the edge, so as to make strips which can be turned back and fastened so as to protect the edges of the hole in the plaster. A hole must also be cut in the shirt, when the sores will be exposed and dressings can be applied.

A jacket so adjusted can be worn for several months (cleanliness having of course to be foregone for that time). It can be removed either by sawing it open with an instrument adapted for the purpose, or by cutting it with suitable pliers.

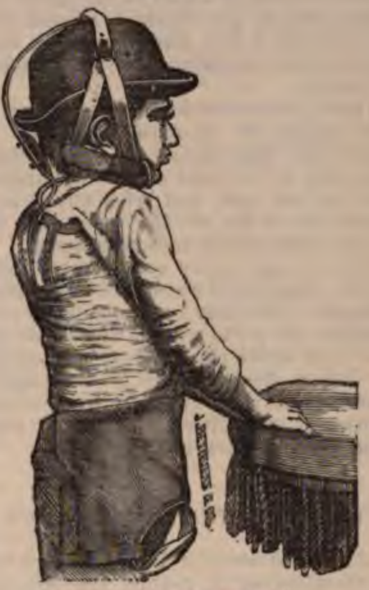
When there is disease of the cervical vertebræ, rendering it desirable to afford support to the head, the device called by Dr. Sayre his "jury-mast" answers an excellent purpose. It consists of a curved shaft over the head, from which the latter may be suspended by a padded leather sling, the lower extremity of the shaft being attached, so as to be raised or lowered at will, to a frame contained between the layers of the plaster-jacket. Fig. 902 shows the arrangement, and in fig. 903 it is seen applied.]

[Fig. 902.



Sayre's jury-mast.

Fig. 903.



Sayre's jury-mast applied.]

Starch, white-of-egg, and dextrine, are all used in their fluid forms as stiffening materials for bandages. The roller may be soaked in a solution of one or the other of these substances previous to its application; or again, the roller being cut into short pieces, each half as long again as the circumference of the limb, these portions may be applied separately to the part from below upwards; the opposite ends of each piece crossing one another over the anterior aspect of the limb, and each succeeding piece overlapping the one that went before it by one-third of its width. Strips of paper soaked in any of the above-named solutions may be advantageously applied in the manner just described.

[A very excellent mode of attaining the same end is by the use of a saturated solution of silicate of potash (soluble glass), painted on over the turns of an ordinary roller. Here also several successive layers of bandage should be applied. Solidification generally occurs very rapidly.]

Gutta-percha, *pasteboard*, *millboard*, or *leather*, may be used in combination with any of the above stiffening materials to give additional firmness and permanency to the application. These, being cut into pieces of the required dimensions must be moulded to the shape of the part while in a pliant condition.

Gutta-percha is rendered fit for application by plunging it for a minute or two into *hot* water. Millboard, pasteboard, and leather, may be prepared for use by soaking them for a sufficient time in *warm* water. Before applying splints formed of these materials to a limb, the whole part should be carefully swathed in a layer of cotton-wool. In many hospitals it is the practice first to envelop the limb in a dry roller, and, having moulded pasteboard splints to fit the parts, to fix these by applying a bandage previously saturated with a thick solution of starch. The material called Hide's felt, being lined with wash-leather, can be applied next to the skin.

In adjusting the immovable apparatus to a compound fracture, or to any part where it is desirable that an aperture should exist for the escape of matter or for the dressing of a wound, the application should be effected in the ordinary manner, and subsequently the bandage over the wound or sinus may be cut away to the necessary extent.

One great advantage attaching to the form of apparatus under consideration is the manner in which it may be adapted to changes in the size of the limb. When, from swelling of the parts beneath, it is necessary to loosen the bandage, the whole application should be cut from end to end with strong scissors or a knife, on the anterior aspect of the limb; this will entirely relax the parts. Subsequently the degree of support and pressure to be exercised may be regulated by passing straps and buckles around the case in which the limb now lies, and tightening or loosening these as occasion may require.

Where, from subsidence of swelling or other causes, it becomes necessary to tighten the application, a longitudinal strip may be cut out of the apparatus from end to end, and with straps and buckles the sides of the case may be brought more nearly into apposition.

There is sometimes considerable difficulty in removing the so-called immovable apparatus; this may be overcome by surrounding the parts with a wet cloth for some time before the removal is attempted. When the bandage is thoroughly soaked, it may be uncoiled from above downwards with little difficulty, or it may be cut with scissors, layer by layer.[1]

SUTURES AND THEIR APPLICATION.

Sutures are used for bringing together and maintaining in contact the opposed surfaces of wounds. They differ both in the method of their application and the material of which they are composed: this difference is owing to the varying necessities of wounds, as these vary in character, or occur in one or another part of the body. There are four principal varieties in the method of applying sutures: (1) the continuous; (2) the interrupted; (3) the twisted; (4) the quilled; in these the material employed may be silken or hempen thread, horsehair, iron, or silver wire.[2] Under the head of each of the principal forms of suture, the material of which it may be composed will be referred to more particularly.

To save subsequent repetition, certain general principles applicable to all forms of suture will be noticed. In passing the needle, the edges of the wound may be advantageously held in contact with the forefinger and thumb of the left hand, or they may be simultaneously tightened so as to bring them parallel to each other, that their opposite and corresponding parts may exactly coincide. The needle should penetrate the surface at an angle of 50°, and should at least pass through the whole thickness of the integument at each stitch; as a general rule the thread should penetrate to a sufficient depth to avoid leaving beneath it in the wound any considerable cavity or space in which pus can accumulate. The distance from the edge of the wound at which the suture should enter and leave the part, must necessarily vary with the depth of the wound and the amount of tension to which the thread will be subject, but in no case should there be less than the eighth of an inch between the suture-hole and the margin of the wound. Sutures, as a rule, ought not to include vessels, nerves, fasciæ, muscles, or tendons. Where more than one suture is used, the interval between the points of suture in the wound should be sufficiently small to overcome any tendency there may be for the edges of the wound to evert, or the fat and subcutaneous tissue to bulge. The line of the thread ought to cross that of the wound at right angles; and in cases where the thread has to be tied, care should be taken that the knot may fall on one side of the line of contact of the edges of the wound. A single knot having been tied, some precautions should be taken to prevent its slipping while the second knot is prepared. This may be tied firmly, but need not be tightened by the exercise of any force; the fingers are sufficiently strong to effect its proper adjustment, without making unnecessary or unseemly muscular efforts.

The size of the needle employed for passing continuous or interrupted sutures should be adapted to that of the thread to be carried, and to the depth of the tissues to be traversed. The shape of the needle, whether straight or curved, should bear relation to the situation and nature of the wound. For incised wounds on the exterior of the body, where the edges can only be transfixed from the cutaneous surface, or where the opposite margins of the wound can both be traversed by one plunge, a curved needle is best adapted; whereas a strong straight needle is more convenient for the completely free margins of extensive wounds, such as are left by the removal of large tumors, or after amputations.

The continuous suture [fig. 904] is for the most part used for the accurate apposition of wounds having thin and delicate edges, such as those of the eyelids or intestines. The application consists in the simple sewing together of the wound from side to side; the first stitch being tied, to prevent its pulling through. This form of suture may be fastened off by knotting together the free end of the thread with the stitch last passed; or by clamping with a small perforated shot; it can be removed by cutting with fine-pointed scissors each portion of the thread as it passes across the line of the wound, and subsequently withdrawing these portions separately. Silk, fine thread, horsehair, or silver-wire may be used for the continuous suture, and the needle should be small and curved at its point.

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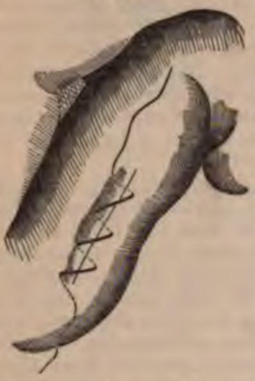
[1] Or a piece of wide tape is laid beneath the bandage at the time of its application, the lower end being left hanging out; this is used to raise the bandage upon, while it is divided with the scissors.

[2] The shotted suture, the clamps and other forms attaching themselves to special regions of the body, will be found described in the essay on PLASTIC SURGERY, and in the account of the various plastic operations.

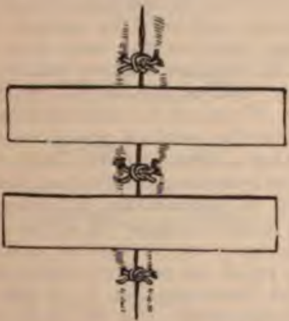
[Fig. 904.



The continued, or glover's suture.]

The interrupted suture [fig. 905] is more general in its adaptation than any other form, being used in wounds of almost every description. Although from its very nature it does not maintain the surfaces of a wound in such close and absolute contact as can be secured by the continuous or twisted suture, yet it possesses certain advantages over these, both in the facility with which it is applied and subsequently withdrawn (piecemeal if need be), and in that while it puts the parts in such a condition that union is most likely to take place, yet, in the event of the healing process being retarded, it offers no serious obstacle to the discharge of matter. For the application of this suture the needle may be either curved or straight, its form varying with the disposition of the parts to which it is to be applied. The peculiarity from which is derived the name of this form of suture, consists in the cutting of the thread after each complete stitch, and tying the ends together, over, or rather just on one side of, the line of the wound. In wounds with edges of considerable thickness and extent, the needle is generally passed separately through the opposite margins, being first introduced from the cutaneous surface towards the deeper aspect of the parts, and subsequently from the cavity of the wound towards the surface of the body.

[Fig. 905.



Interrupted suture (Gross).]

Silken and hempen thread, the materials formerly made use of for the interrupted suture, have now very generally given place to silver or iron wire. These latter possess most decided advantages over silk, or any thread of vegetable origin, in their cleanliness, and in the diminished tendency they show to excite irritation in the tissues through which they pass.[1] For the introduction of metallic wire, as a substitute for threads of organic origin, we are greatly indebted to Sir J. Simpson, of Edinburgh, who, by the publication of the results of his experiments on animals, and by the success that attended his use of the same suture in man, first drew general attention to the subject in this country. In 1849, Dr. J. Marion Sims was the first to apply the same description of suture in America.[2] Dr. Sims's claims to priority had, however, been anticipated (at least so far as the principle involved was concerned) some two hundred years before by Fabricius ab Aquapendente, who, writing in 1647, refers to the imperfections of the materials for suture at that time in use, namely, that they excited irritation, produced discharge, and easily ulcerated out. As a substitute, he recommends iron or brass wire sharpened at one extremity and annealed elsewhere, thus forming both needle and suture of one continuous piece of metal.[1] Again, in our own country, in the year 1834, Mr. Gossett[2] successfully treated a case of vesico-vaginal fistula by silver-gilt wire sutures, and curiously enough, adopted the same position for the patient that is now found most convenient for the performance of the operation; a position, the advantages of which Dr. Marion Sims believed himself to have been the first to discover.

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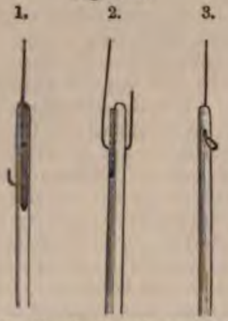
[1] My personal experience, in opposition to Sir J. Y. Simpson's observations, leads me to give a decided preference to silver over iron as a material for metallic suture, and this is, I believe, in accordance with the opinion entertained at most of our metropolitan hospitals.

[2] Anniversary Discourse, 1858, before the New York Academy of Medicine.

For carrying a metallic thread, an ordinary needle of rather large size, and pretty deeply grooved behind the eye, may be employed, or one of those specially made for passing this description of suture. Of these there are three varieties (fig. 906), namely, that invented by Mr. Price, having two eyes, and being deeply grooved, 1; Mr. Lister's furnished with one eye, and grooved laterally, 2; and that recommended by Mr. Murray, having an open end, and a groove on the side to admit of the end of the wire being doubled on itself, 3. Silver wire, if kept long, soon loses its softness and pliability, and becomes unfit for sutures; it may be reannealed at any time, and best of all just before it is required for use. Metallic sutures are generally fastened off by first crossing, and then twisting, the opposite ends of the wire together, until sufficiently secure to resist the tension to which they will be exposed; a better way is by tying the ends together in a double knot. In applying these sutures to the prepuce or elsewhere, where the edges of the wound are thin and delicate in structure, and the tissues around of lax disposition, some care must be taken lest the edges of the wound themselves be twisted and bruised in the process of fastening the suture. For horsehair sutures a very fine needle may be used, the hair being fastened through the eye of the needle by a single knot.

Fig. 906.



Needles for the wire-suture.

[An extremely convenient plan is to use a needle with an eye near the point, thrusting it through the tissues, passing the wire through the eye, and withdrawing the needle, thus bringing the wire with it. For many years I have found this method equally available for all sorts of wounds. The needle, which is essentially the same as that devised by Mr. Baker Brown for ruptured perineum, may either be set in a handle or held in a needle-carrier.]

When the interrupted suture is formed of silk or thread, it is easily removed by dividing it with the point of the scissors just away from the knot, grasping this in the forceps, and gently drawing out the suture. Metallic threads may be removed by cutting the wire and straightening the ends before withdrawing it, or better, by cutting away a portion of the wire—nearly all the parts exposed to view,—and withdrawing the remainder with the forceps, pulling towards the line of the wound, so as to make the wire describe a slight curve in its exit, suited to the shape which it has assumed. The foregoing is one of the best methods of removing metallic sutures, a proceeding which, owing to the stiffening of the wire, is liable to be somewhat painful in its execution, unless some such plan as the above be adopted; this difficulty in their removal seems to be the great drawback to the employment of metallic sutures. It is inexpedient, particularly in hospital practice, to leave metallic sutures in a wound, in the hope that they will slough out; the wire, or at least so much of it as is beneath the skin, will in the majority of cases become encysted, and may subsequently prove a considerable source of inconvenience.[1] As an instance of the tolerance of metallic sutures exhibited by certain tissues, we may mention the case of a woman who still retains a silver suture in the anterior wall of the vagina, introduced by Mr. Wormald several months previously for the cure of vesico-vaginal fistula; this patient has since borne a child.

Before removing interrupted sutures, it is usual to support the intervals of the wound between them by strips of adhesive plaster: but for further information on this point the reader is referred to the essay on WOUNDS, Vol. I., p. 394.

The twisted suture [fig. 907] will retain in immediate contact the whole surfaces of a wound of considerable depth; it is employed in the operation for hare-lip, in many wounds of the face, especially such as lay open the cavity of the mouth, and in extensive wounds of the abdominal walls.

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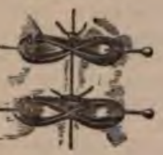
[1] See Dr. Aveling's letter to Medical Times and Gazette, January 22, 1859, where the whole passage from Fabricius is quoted at length.

[2] Lancet, November 29, 1834.

[1] A fine silver ligature, which had been placed on the radial artery at the wrist, was removed three months afterwards by myself, on account of the inconvenience it caused the patient.

[Fig. 907.

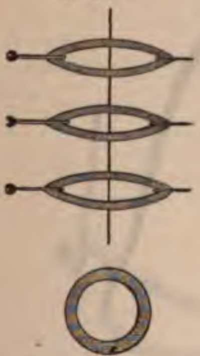


The twisted suture.]

Hare-lip pins, cutting wire-pliers, and silk, twine, or some soft thick thread, are required for its application.

The edges of the wound being held in contact, or at all events being carefully maintained in the same horizontal plane, the pin should be made to transfix the wound, entering the skin from half an inch to an inch from one of its margins, and appearing at the same distance beyond the opposite. The requisite number of pins having been passed, a piece of silk, or whatever other material is chosen for the suture, should be twisted over each pin in the form of the figure 8, so that the circles of the figure surround the extremities of the pin, and the crossing of the thread lies over the line of the wound. The same thread may be made to serve for all the sutures, provided it is sufficiently long, being passed continuously from one pin to the next below it. The opposite ends of the ligature being tied together, each pin may be shortened at its pointed extremity, and adjusted so as to leave about half an inch projecting on eitherside. The skin may be protected from these rough cut ends by passing beneath them a strip of soft lint · and the whole is best covered with the same material dipped in oil. [Another plan is to slip over each pin a small rubber loop, as in fig. 908. This makes a very neat arrangement, and holds very well.] In withdrawing this form of suture, the heads of the pins should be grasped in the forceps, and loosened by a slight rotatory movement; they may then be drawn out, while the finger and thumb are placed on the suture itself, to prevent any traction being exercised on the margins of the wound. When the cut surfaces, to which the twisted suture is applied, are of great thickness, it is sometimes necessary to add a few interrupted sutures at the extreme edges of the wound to prevent the eversion of the fat and subcutaneous tissue.

[Fig. 908.



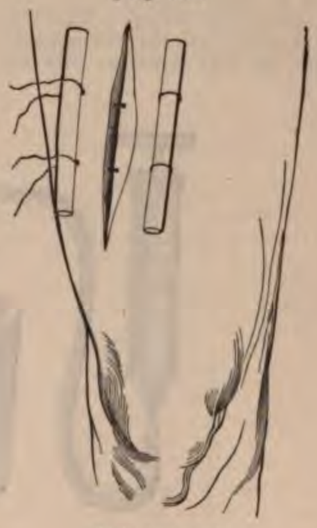
India-rubber suture.]

In applying the twisted suture to the face, or elsewhere where a sightly cicatrix is a consideration, great care is needed, in transfixing the parts, to keep the margins of the wound exactly on the same level. To avoid any doubling-in of the skin, it is well to tilt up the edges of the wound while passing the pin through them.

For this suture the softer varieties of thread possess a considerable advantage over silk or twine; the latter, from the firmness of their texture, being too apt to bruise the soft parts beneath them; on this account some adopt the plan of using narrow strips of lint to wind around the ends of the pins.

The quilled suture [fig. 909] is adapted to wounds of greater depth than those to which the preceding variety of suture should be applied; of itself it can maintain in apposition the deeper parts of such

[Fig. 909.



Quilled suture.]

a wound, and in conjunction with the interrupted suture it will keep in contact the whole surface. In the hands of some it is found very useful in the treatment of lacerated perineum, or it is employed in deep wounds of the buttock and fleshy parts of the thigh. It is best applied with a strong curved needle, fixed in a handle, and having an eye near the point. This should be threaded with the loop of a double thread, formed of some stout material; and having been passed through the wound from side to side, the looped end of the ligature may be detached from the eye and held with the left hand, while the needle is withdrawn. The needle should pierce the skin not nearer than an inch from the edge of the wound, and should traverse the deeper parts, and emerge at the same distance beyond its opposite margin. This proceeding will leave a double thread through the wound with a loop on the one side and two free ends on the opposite. Through the loop (or loops if more than one suture be employed) a piece of gum catheter should be passed, and the thread drawn tightly over it, while the other ends are tied firmly over a similar piece on the opposite side of the wound. To maintain perfect apposition in the more superficial parts, it is generally necessary to add a few interrupted sutures at the extreme margin of the wound.

By cutting the looped ends of the threads this form of suture may easily be removed.

Serres-fines are occasionally employed for bringing together wounds of very thin skin or of mucous membrane. They are small spring-wire forceps; their points are finely serrated, and their handles cross one another, so that when at rest they are closely in contact. The points are generally bent at right angles to the spring, so that the handles of the serres-fines may lie evenly over one another along the line of the wound in an imbricated manner. In adjusting these, one should apply them at regular intervals to the lips of the wound, taking care that the handles of each pair are turned in the same direction, so as to overlap those of the preceding pair; any dressing that the wound may need can be laid on it subsequently. [Serre-fines (fig. 910) are also very often useful in arresting hemorrhage from small arteries, during the performance of operations. A larger instrument, on the same principle, known as "Dieffenbach's forceps" (fig. 911), is employed by many surgeons for the same purpose.

Fig. 910.

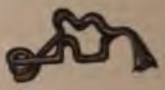
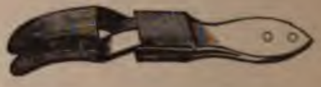


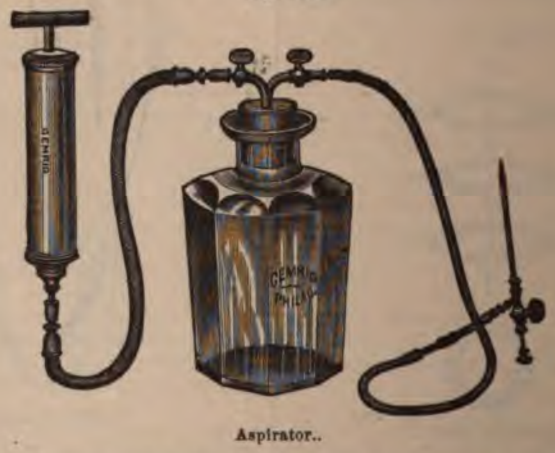
Fig. 911.



ASPIRATION.

In 1869, M. Dieulafoy presented to the profession an instrument called the "aspirator," the principle of which was the evacuation of fluids by what he called a "previous vacuum." With slight modifications, this has now become an article

Fig. 912.



Aspirator..

of almost daily use for drawing off the contents of abscesses, of the pleura in empyema, of the distended bladder, etc.

The instrument is shown in fig. 912, and is used as follows: One of the canulæ, armed with its trocar, is pushed into the cavity to be emptied, at any suitable point (this procedure can be rendered painless by freezing the skin for one minute with a mixture of ice and salt); the metal tip of the rubber tube is next inserted into a pipe at the side of the canula, and the trocar is withdrawn, the stopcock on the canula being instantly turned so as to close it. Now the stopcock in the stopper of the bottle, next the canula, is closed, and the other one opened, when a vacuum is created within the bottle by means of the pump. Closing the latter, and opening the former, the liquid will fill the bottle; then changing the stopcocks again, the stopper may be taken out, the bottle emptied, and the same process repeated as often as may be necessary. When the liquid is all drawn off, the canula is removed, and the little puncture securely closed by means of a strip of plaster.]

COUNTER-IRRITATION.

Counter-irritants, as their name implies, are used for the purpose of exciting local irritation; they vary in degree from simple rubefacients, which merely produce transient congestion of the cutis, to such as completely destroy the tissues exposed to their influence. They may conveniently be studied in two groups—(1) those whose effects are comparatively transient; and (2) those that excite a more permanent local irritation, or that maintain a continued drain on the system. Under the first head are included rubefacients, vesicants, acupuncture, and the like; under the second, the moxa, issues of various kinds, setons, and the actual cautery. *Rubefacients* may be generally defined as applications to the surface of the body, which irritate the cutis sufficiently to produce reddening of the parts, without leading to any of the more serious results of inflammation. For this purpose various liniments are employed, such as the linimentum ammoniæ, l. cantharides, l. acidi acetici, l. terebinthinæ, l. olei crotonis tiglii; the potassio tartrate of antimony in the form of ointment, and mustard-flour in the form of poultice. With the exception of the last named, all these substances may be applied to the surface by friction with a piece of flannel, the skin of the part having been previously cleansed with warm water; the skin may be rubbed until it has acquired a ruddy hue, and a smart tingling sensation is experienced in the parts. Croton oil and the potassio-tartrate of antimony differ from the other substances in this group, in being more decided in their effects, and in producing a characteristic pustular eruption.

Mustard-flour, the most popular and useful of rubefacients, can be used in the form of tissue, or mustard leaves as they are called, or may be made into a poultice with water of a temperature from 90° to 100°; water of a higher temperature than this is liable to coagulate the albumen of the mustard-flour, while a much lower hinders the disengagement of the volatile oil upon which the irritant property of the application depends. Vinegar, which is often mixed with the poultice, has the effect of diminishing its activity. The effect of sinapisms may be in a measure regulated by mixing with the mustard wheat-flour or linseed meal, and by modifying the duration of the time during which they remain in contact with the skin. The London Pharmacopœia directs that equal proportions of linseed-meal and mustard-flour be used; while the time during which the application should remain on may be broadly stated to vary from ten minutes to half an hour. It may best be estimated by observing the texture of the skin of the patient, and being at the same time guided somewhat by his expressions of pain.

When sinapisms are employed to patients in a comatose condition, special care should be taken lest they remain for too long a time in contact with the skin; and this not only on account of the absence of any indications for their removal from the sensations of the patient, but also from the possibility that the part to which they are applied may be already lowered in vitality by the loss of nervous force. This form of rubefacient may be employed to any part of the surface of the body, though it is well not to expose the skin of the face to its influence. Very delicate or irritable skins are best guarded from its undue action by interposing a thin piece of cambric or tissue-paper beneath the poultice. After the removal of the application, the surface should be gently sponged with warm water, and a piece of cotton-wool may be placed over the part; or, if the pain be severe, a piece of linen or lint smeared with simple cerate.

Vesicants are substances which, in contact with the external integument of the body, excite such irritation of the cutis as to determine the effusion of serum from its surface, leading to the separation of cuticle, and the formation of a vesicle. As a general rule they are employed as derivatives or counter-irritants in chronic inflammatory affections; or after the more active symptoms of inflammation have passed by, they are used either to quench the smouldering remains of an acute attack, or to stimulate the absorbents to the more speedy removal of some inflammatory product.

To produce vesication, cantharidine in one of its various forms is generally employed; though liquor ammoniæ, chloroform, or iron heated to 212° F., are occasionally used; it is also said that mezereon bark, soaked in vinegar, and applied to the skin, is capable of raising a blister on the surface.

Cantharidine is employed in the form of the emplastrum cantharidis, blistering fluid, and blistering tissue. The skin of the part being previously well cleansed with warm water, or sponged with vinegar, the application may be so adjusted that it may remain in close contact with the skin; for this purpose the emplastrum cantharidis is generally spread upon diachylon plaster, and the blistering tissue can be fixed with strips of the same material. In cases where, from the delicate texture of the skin, or from known idiosyncrasy, there is fear lest urinary irritation arise from absorption of the cantharidine, the surface of the blister may be dusted over with powdered camphor, or better, a piece of oiled tissue-paper may be interposed between the blister and the skin. In no case should the application be made over a raw surface, nor, if avoidable, on the site of a recent cupping. The employment of blisters is not admissible in the case of children suffering from any low or exhausting form of disease; in them sinapisms will be found to produce quite as much irritation of the cutaneous surface as it is safe to employ. The period during which the preparations of cantharidine should be allowed to remain in contact with the skin varies so greatly, and is dependent on such diverse conditions of sex, age, and idiosyncrasy, that we cannot attempt to lay down any general rules on the subject; the patient's own sensations will afford some guide to the amount of irritation that has been excited: if the application be slightly raised, it can be ascertained whether any effusion of serum has taken place. If a blister has been applied during some hours without producing the desired effect, it will be well to remove it; and should any considerable reddening of the surface exist, a warm linseed meal poultice applied to the part will often suffice to determine a copious effusion of serum from the surface of the cutis.

Vesication may be more rapidly produced by the application of the liquor ammoniæ, or iron heated in boiling water, to the surface of the body. These agents are but rarely employed in this country, though the one or the other might be advantageously employed where rapid denudation of the cutis is required, for the application of remedies by the endermic method. One of the best plans of using the liquor ammoniæ is to steep a piece of lint the size of the part to be vesicated in the strong solution, and apply it to the skin until the ammonia has passed off by evaporation; in most cases this will almost immediately raise a blister. A very manageable and speedy counter-irritant, which at the same time appears to possess a certain local anæsthetic property, has been introduced by Mr. Little, of Singapore. It consists of a small piece of lint steeped in chloroform, and covered entirely with a watch-glass, applied to the skin and gently pressed down with the palm of the warm hand. It may remain in contact with the skin from five to ten minutes, when it will generally be found to have produced pretty decided reddening of the part, and occasionally vesication. This application has been found especially suited for facial neuralgia, or rheumatic affections of the sciatic and other nerves.

To apply the heated iron as a vesicant, an ordinary hammer with a flat head, or better Dr. Corrigan's thermal hammer, as it is called, should be heated in a spirit lamp or plunged into boiling water for about a minute, dried, and immediately applied to the part to be blistered; the contact of one or two seconds is sufficient to produce the desired effect. Such a hammer immersed in water at 120° F., and held for two or three seconds in contact with the skin, will act as a rubefacient; while, if allowed to remain in contact from five to ten seconds, it will generally produce vesication.

Whatever means are employed to produce the effusion of serum beneath the cuticle, the subsequent treatment of the vesicle must be pursued with one of two objects in view; either to render the injury to the part as transient as possible, and to restore the integrity of the cuticle, or to establish a permanently secreting surface. To effect the former, the vesicle, being opened with a large puncture at its most dependent part, may be allowed to empty itself; subsequently it may be covered with a layer of cotton-wool, which can remain undisturbed until the new cuticle be formed beneath; or after the evacuation of the serum, the part may be dressed with simple cerate spread on linen or lint. If, however, the blister is to be kept open, the cuticle being pinched up with the forceps may be divided with the scissors around the circumference of the vesicle, and removed at once, the raw surface being dressed with ceratum sabinæ, or whatever other application is selected as an irritant. This process of stripping off the cuticle, and at once exposing the denuded cutis to an irritant ointment and the external air, is extremely painful; the pain may, however, be avoided by leaving the cuticle in contact with the surface of the part after dividing its connections in the manner above described; the dressing may be applied over the cuticle, and the latter will separate in a few days, thus leaving a raw surface that will gradually have become inured to the stimulus of the external air.

Various irritating applications are made use of to maintain a constant secretion from blistered surfaces; the unguentum sabinæ, or the ceratum and unguentum cantharidis, are usually employed, spread on lint or linen rag. A convenient and nearly painless irritant is found in the *papier épispastique*, which is kept by most chemists: at each fresh dressing the part should be cleansed with warm water; a process needed as a general rule every day, and in summer weather twice during the twenty-four hours. There is a limit to the time during which a blistered surface should be kept discharging; when the granulations become large, spongy, or tuberculated in appearance, it is well to discontinue irritant applications, lest an uneven and unsightly cicatrix be produced.

When vesication has been employed to allow of the introduction of drugs into the system by the endermic method, the blister may be opened by a small puncture, which should not be situated on the most dependent aspect of the vesicle. The serum being pressed out, the substance to be administered may be introduced through the opening in solution, by means of a small syringe, or it may be applied in powder to the raw surface of the cutis. The foregoing method is now, however, superseded by the introduction of Dr. Wood's syringe and hollow needle, by means of which substances can readily be introduced into the subcutaneous cellular tissue.

The *hypodermic* or *subcutaneous* method of medication, introduced by Dr. Alexander Wood, is specially adapted to the administration of anodynes. We are largely indebted to Mr. Charles Hunter[1] for a more precise knowledge of its varied uses and general effects on the system, and for a demonstration of the more speedy and powerful action of drugs given hypodermically as compared with the effects of similar doses taken into the stomach. Morphia injected subcutaneously has a less disordering effect on the stomach than when given by the mouth; while from the manner of its administration it can be given in conditions when the irritability of that organ would otherwise preclude its use.

The solution of morphia generally used is one consisting of ten grains of the acetate of morphia to a drachm of distilled water; acetic acid being added in sufficient quantity to dissolve the salt; liquor potassæ is then added, drop by drop, until a slight film is produced, so that there may be no excess of acetic acid; from one-sixth to one-third of a grain of the salt is the usual dose, or from one to three minims of the solution.

[A more convenient way is to carry in the hypodermic syringe case some powders of half a grain each of sulphate of morphia. When they are to be used, the requisite quantity may be sufficiently nearly separated with the blade of a penknife (if less than half a grain is desired to be given), and put in a sherry-glass. The surgeon next draws up into the syringe as much *hot* water as he wishes to use, and throws it on the powder, dissolving the latter. The syringe is now recharged by drawing the water back into it, and the injection may be given. Dr. H. A. Wilson, of this city, has recently called attention to the value of soluble pellets containing morphia in suitable doses for hypodermic administration; they are used much like the powders just referred to. Most druggists keep them for sale.]

If the general constitutional effects alone of the drug be required, it may be introduced into the subcutaneous tissue of the forearm, or at any other convenient spot; but if, as in the case of some neuralgiæ, a more local action is desirable, the injection may be made near the seat of pain. Whatever part be selected, the skin being pinched up between the forefinger and thumb, the tubular needle may be thrust in, and the solution injected.[1]

Permanent counter-irritation may be maintained by means of the repeated application of blisters, each succeeding one being applied so soon as the one that preceded it has ceased to discharge. This plan seems to exercise a more decidedly counter-irritant effect; it is less irksome to the patient; and in chronic inflammatory affections of the joints, and analogous cases, it is an excellent substitute for some of the more formidable counter-irritants.

As a vesicant and general counter-irritant, nitrate of silver has been most strongly recommended by Mr. Higginbottom; and to his interesting pamphlet on the subject the reader is referred for an elaborate account of its action, and its various applications to surgery.

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[1] Med. Times and Gazette, 1859.

[1] See "Report of Committee on the Hypodermic Method of Injection," Med.-Chir. Trans., vol. i., which confirms the conclusions previously announced by Mr. C. Hunter.

Acupuncture.—This operation consists in the introduction of sharp-pointed needles into the subcutaneous tissue of the body; these are allowed to remain for a longer or shorter time, and are then withdrawn. Its chief use is in neuralgic affections, particularly those of the sciatic nerve, where it is employed for its counter-irritant effect. Its efficacy in certain obscure cases of painful rigidity is highly spoken of by Dr. F. Ogier Ward, who recommends the insertion of the needles among the muscular fibres, retaining them there for some time. As a purely mechanical agent, acupuncture is made use of to drain away œdematous effusions in the subcutaneous cellular tissue. The needles for this purpose are made short and strong, and fixed in cylindrical handles. They may be introduced by drilling through the skin with a rapid rotatory movement, effected between the forefinger and thumb of the right hand, the skin of the part being at the same time stretched between the fingers and thumb of the left hand; when the needle is withdrawn, the rotatory movement should be again adopted to facilitate its exit. Acupuncture is sometimes effected by percussion; the point of the needle being placed upon the skin, its handle is smartly struck so as to drive it suddenly through the integuments; lastly, the needle may be introduced with a sudden stabbing movement. In withdrawing the needle in either of the last-named methods, the skin on either side the puncture should be held down with the finger and thumb. Of the three plans the first seems to exercise the most decidedly counter-irritant effect.

Electro-puncture is nothing more than the application of a galvanic current to the tissues included between two acupuncture needles; these are introduced in the ordinary manner, and the negative and positive pole of the battery being connected respectively to one and the other of the needles, the current may be established between them. This form of counter-irritation is employed in the same description of cases as the acupuncture; its application, however, is far more painful; its chief use lies in the means which it affords of directly acting upon paralyzed muscles.

Under the more permanent forms of counter-irritation are included (1) issues of various kinds; (2) setons; (3) the application of the actual cautery.

1. Issues are sores artificially produced, giving exit to a continued discharge; they are employed for local causes as counter-irritants; or for constitutional maladies, to establish a perpetual drain on the system. When instituted for the latter purpose, some part of the body should be chosen where the subcutaneous cellular tissue is abundant, and also convenient by its position for subsequent dressing of the sore. Prominent points of bone and the neighborhood of large veins, or cutaneous nerves, should be carefully avoided; the upper and outer part of the arm just below the insertion of the deltoid is the common spot selected for the formation of an issue; or on the lower extremity they may be conveniently placed on the inner side of the thigh, just above the knee-joint, and clear of the saphena vein. Though there is but little room for choice of situation when issues are applied for local purposes, yet the general rules that are mentioned above should, if possible, be observed.

Issues may be established by means of (*a*) various caustics, (*b*) the moxa, or (*c*) the use of the knife.

(*a*) For the formation of caustic issues, either caustic potash or Vienna paste is generally employed. To apply the caustic potash, a piece of plaster having a small hole cut in its centre, half the size of the intended issue, should be applied to the part to protect the surrounding skin; a bit of potash, the size of a small pea, may be placed over the hole in the plaster, and covered with a layer of soft lint; the whole may be retained in position by strapping, and should remain undisturbed until the caustic has exercised its full effect, that is, until it has destroyed the entire thickness of the skin; and this will generally take place in about four hours. On removing the application an ash-colored central slough should be seen, surrounded by a bright halo of congestion; simple dressing or a poultice may be applied until the dead parts separate.[1] The size of the slough will generally be fully twice as large as that of the hole in the plaster; its depth will depend upon the quantity of the caustic employed. A more convenient method of applying the caustic potash is by mixing it with soap, in the proportion of three parts of the former to two of the latter; this diminishes the tendency of the potash to diffuse itself over the surrounding skin, and at the same time does not materially lessen its activity. *Vienna paste* is a mixture of five parts of caustic potash with six parts of quick-lime. This compound possesses decided advantages over the caustic potash, in the greater rapidity of its action, and in being more easily confined to the spot to which it is applied. The powder should be made into the consistence of a paste by mixing it with alcohol; and being applied to the skin in the same manner and with the same precautions as the caustic potash, may be allowed to remain in contact for fifteen or twenty minutes, or longer if the integuments of the part are very dense. After the removal of the paste the parts may be gently washed with warm water, and simple dressing or a poultice applied until the slough separates.

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[1] Before applying the poultice, all remains of the caustic should be carefully removed, and this is best effected by sponging the part with a solution of acetic acid.

(*b*) The actual cautery in the form of the moxa, though generally employed for its immediate irritant effects, is not unfrequently made use of for the formation of issues; for this purpose it is preferred by some surgeons as exercising a more decidedly counter-irritant effect, especially in certain affections of the joints, and in carious diseases of the bones of the spinal column. The moxa is a tightly packed solid cylinder of cotton-wool, fitting into a metallic tube, open at both ends, and attached to a handle. The moxa being introduced into this tube, one end should be thoroughly ignited; and the opposite end being held in contact with the skin of the part, a continuous current of air should be maintained against its surface by means of a blowpipe, until the whole of the cotton-wool be consumed. Meantime the surrounding parts may be protected from injury by covering them with a thick layer of wet lint. The size of the eschar will be somewhat greater than that of the end of the metallic tube employed. Moxas may be prepared by soaking the cotton-wool in a strong solution of nitrate of potash, and subsequently drying them; in the application of these the use of the blowpipe may be dispensed with. [The tube is not necessary; the cotton may be simply bound with a thread into a cylinder, and held for application in a pair of ordinary dressing forceps.] The pain of the moxa is excessive during its application, but is not of long duration; the resulting slough is dry, dark-colored, and cracked on its surface, and the surrounding integuments are brightly congested; the slough may be treated in the same manner as in other caustic issues. After the separation of the dead parts, the wound is generally allowed to granulate and heal up, but it may subsequently be treated as an ordinary issue.

(*c*) Issues are made with a knife by pinching up a fold of skin between the forefinger and thumb, rapidly transfixing it, and cutting it through, the cutting edge of the knife being turned upwards; or the integuments being put on the stretch, a crucial incision may be made extending into the subcutaneous tissue.

Having described the principal methods of forming issues, it now remains to allude briefly to the various plans adopted for keeping them open. So soon as the eschar separates in the case of the caustic issues, and at the time of their formation when the knife is used, one or more glass beads or issue-peas may be applied to the surface of the sore, and there retained in firm contact with the parts by means of strapping for four or five days. When suppuration is fully established, the wound should be cleansed daily, the peas being removed and replaced at each dressing; should the granulations become too exuberant, they may be touched occasionally with nitrate of silver. To prevent the wound healing, it is occasionally necessary to reapply the caustic potash or Vienna paste; but a more convenient and less painful method of effecting the same purpose is to dress the surface from time to time with the *papier épispastique*, or the issue-peas may be occasionally smeared with some irritating ointment.

Of the various methods employed for establishing issues, that by means of the moxa is the most decided in its counter-irritant properties; its effects are produced more quickly, and the issue thus formed can be kept discharging for a longer period than any other; at the same time this plan is exceedingly painful in its application. Issues formed by caustic potash or Vienna paste rank next for efficacy and permanency; while those formed by means of the knife, are both difficult to keep open and more scanty in their secretion than others, though they have the advantage of being painless in their application, since local anæsthesia can be employed.

Setons.—A seton is an artificially-produced sinus, through the track of which some material is passed to excite suppuration, and to maintain the patency of its orifices. They are established in the subcutaneous tissue of the body, (*a*) as counter-irritants, or (*b*) to act as continued sources of drain on the system. As local irritants, they are passed through various cavities to excite inflammation and procure adhesion of the opposite surfaces; or again, they are used as means of gradually evacuating the contents of cysts, chronic abscesses, and other abnormal cavities. For the purposes of counter-irritation, setons are generally inserted in the neigborhood of the part affected; as for instance, in front or behind the ear in certain chronic affections of the eye, or over the pubes in certain diseases of the bladder. But when employed to act as drains on the system at large, the nape of the neck is the part generally selected for their insertion. To establish a seton in the subcutaneous tissue (the part having been rendered insensible with ether spray), a fold of skin should be grasped and raised from the deeper structures; this should be transfixed at its base by the instrument carrying the seton rather obliquely, so that one of the openings in the skin shall be more dependent in position than the other. The size of the fold of skin to be transfixed will depend upon the length of the seton; but in all cases the needle must pass deeply through the subcutaneous tissue, and not immediately beneath the skin, or the latter will slough over the whole track of the wound. On the nape of the neck a longitudinal fold of skin over the spines of the cervical vertebræ is generally raised and transfixed nearly at right angles to the axis of the spine. The instruments used vary with the material of which the seton is to be composed; thus, ordinary needles of various sizes are employed when one or more silken or wire threads are to be introduced, whereas, if a gum-elastic band is used to keep the wound open, a properly adapted seton-needle should be employed; though in the absence of this, the parts may be transfixed with a double-edged bistoury, which will also serve as a guide for the introduction of the seton.

Whatever material is employed to keep the wound open and excite discharge, it should first be smeared with oil; and having been introduced, may be allowed to remain undisturbed for four or five days, or until suppuration is fairly established; subsequently the dressing may be changed daily, and the seton be pulled on each occasion a little further through the wound, care being taken to oil that part of it which is to occupy the wound, before moving it. If the seton be composed of silken or other threads, when it is nearly all pulled through the wound, a fresh piece of the same material may be attached to its end, and thus drawn into the sinus. Gutta-percha or gum elastic bands need only be shifted each day one way or the other, the projecting ends being carefully wiped, so that the discharge does not accumulate and harden upon them. In the subsequent progress of the case it may be occasionally necessary to smear the ends of the seton with some irritating ointment to produce a more copious discharge from the wound.

For exciting local inflammation and adhesion the seton is employed in the treatment of hydrocele, enlarged bursæ, ranula, and elsewhere. For such a purpose, a single thread, or a silver wire, is passed through the cavity with an ordinary needle; or if the cyst be large, a needle fixed in a handle, and having an eye at its point, may be used.

Setons are nowadays but rarely employed for emptying large cysts or chronic abscesses, their use for this purpose having been superseded by the drainage-tube of M. Chassaignac. For purposes of drainage from suppurating cavities or cysts, a far more effectual and cleanly appliance has been devised by Mr. Robert Ellis in his spiral-wire drainage tubes.

The *actual cautery* is some metallic substance raised to an elevated temperature, and applied to the tissues of the body; steel, iron, and platinum are the only metals now employed for this purpose. This form of cautery is made use of for arresting hemorrhage, for destroying diseased surfaces and morbid growths, and for exciting counter-irritation of almost every degree, from simple rubefaction up to complete destruction of the skin and subcutaneous tissue.

Cauteries are made of steel, fixed in wooden handles; their heads or extremities are of various shapes, being bulbous, conical, hatchet-shaped, or hammer-headed, varying with the special purpose or part of the body to which they are applied. They may be heated in an ordinary fire, or by means of a spirit-lamp. Three degrees of temperature are generally recognized; namely, white heat, red heat, and an inferior degree when the metal is black, or as hot as it can be without losing its natural color. As a general rule, the hotter the metal is at the time of application, the less pain will it produce. The well-known gas cautery apparatus devised by the late Mr. Bruce, is a most convenient and valuable form of cautery.

In making use of the actual cautery to a raw surface, whether for the suppression of hemorrhage or for other purposes, the surface should first be carefully dried; the iron, flat-headed or conical in shape, may then be applied to the part with a light hand, being kept in motion, or at all events not allowed to remain in contact with any one part of the wound for more than a second or two, otherwise the disorganized tissues will stick to the metal, causing great pain, and often considerable hemorrhage when the instrument is removed. When the hot iron is applied to the sound skin for its counter-irritant effects, a hatchet-shaped cautery is generally employed; the thin edge of this may be drawn rapidly and lightly over the surface in parallel lines, an inch or more apart. There are certain parts of the body to which this remedial measure should not be applied; these may be stated to be the immediate neighborhood of subcutaneous bones, such as the vault of the skull and the sternum; salient points of bone, as the acromion, olecranon, patella; the course of the larynx or trachea; superficial tendons, and the neighborhood of such synovial membranes as lie very near the surface. The effect of the heated iron may be varied in degree by holding it at a greater or less distance from the skin. Its indirect application is thus employed by many continental surgeons as a stimulant to ulcers or unhealthy wounds; the cautery being held first at some distance from the part, and being gradually approximated until the surface of the sore is covered with a thin dry scab.

For the destruction of morbid growths or cancerous ulcers, the actual cautery may be retained in contact with the diseased tissues, freshly-heated cauteries may be frequently renewed until complete charring of the parts has been effected, or the gas cautery apparatus may be employed. It may not be out of place to remark that great caution should be used in applying the cautery to a part where local anæsthesia has been induced by Dr. Richardson's spray-producer.

Bloodletting.

For the convenience of description, this remedial measure may be considered first in its local, and secondly in its general application. In local bloodletting the blood is drawn from the capillaries; this may be effected by leeching, scarification, or cupping. General bloodletting includes venesection and arteriotomy.

Leeching.—[In the United States the leeches used are generally imported, and known as "Swedish," although many are brought from Spain. The American leech, such as abounds in our ponds, is much less vigorous, each one drawing scarcely a fluidrachm of blood, while a foreign one will take four times as much, or even more. The former has a reddish-brown belly, the latter a greenish-yellow one, with two rows of black spots.] Leeches should be removed from water an hour or two before their application, and, having been carefully dried in a clean cloth, they may be applied to the skin of the part, after it has been carefully cleansed, freed from hair, if that exist in any quantity, and, if need be, smeared with a little milk [or with blood from the finger] to induce the leeches to bite. If the blood is to be abstracted from the external surface of the body, the leeches may be conveniently covered with an inverted tumbler or wine-glass until they have attached themselves; or they may be placed in the hollow of a large and loosely made pad of cotton-wool covered with lint; or a clean towel may be folded so as to contain them, and being inverted over the part, may be maintained in position by gentle pressure. Again, two or three may be placed together in an open pill-box, which must be inverted and maintained in contact with the part. When it is desirable more exactly to localize the point of application, as in leeching the gums, eyelid, or lacrymal sac, the leech can be retained in position, until it has attached itself, by means of a leech-glass, or a card rolled up in a cylindrical shape. When there are but few leeches to be applied to the external surface of the body, each may be held singly between the forefinger and thumb, while its mouth is directed to the part to which it is intended it should attach itself. There are certain parts of the body where particular precautions should be adopted in abstracting blood by this means. To the eyelid, nasal mucous membrane, lacrymal sac, and cavity of the mouth, a leech-glass or rolled card ought always to be used. In leeching the eyelid, the patient should be placed in the recumbent position, and should thus remain for some time; this will generally obviate the unsightly ecchymosis which is apt to occur in the loose cellular tissue of the part.[1] Leeches may be applied to the os uteri by first introducing a speculum, thus protecting the vagina and leaving the os uteri free and projecting into the cavity of the instrument; they may then be pushed down the speculum, and maintained in contact with the os by means of a pledget of cotton-wool until they have attached themselves.

A healthy leech will draw about ʒij of blood, and this quantity may be increased by subsequent fomentation of the bite to about ℥ss. It is said that the capacity for abstracting blood may be largely increased in leeches by making minute punctures on their dorsal surface, just above the caudal extremity; of course this proceeding cannot be adopted until the leech is firmly attached and well distended with blood; it is a measure, one would think, of very equivocal advantage. When leeches, though fully distended, still remain attached to the surface, the popular applications of salt or snuff to their bodies will generally induce them to relax their hold.

To obtain a further flow of blood from the bites after the separation of the leeches, warm linseed poultices or fomentations with warm flannels are generally employed, or the part, if on one of the extremities of the body, may be immersed in warm water. When it is desirable to arrest the hemorrhage at once, the bites may be freely exposed to the air, or the part being covered with lint or a dry cloth, pressure over it may be made with the hand, or maintained by a bandage; should this be insufficient, a little shredded lint being placed over each bite, firm pressure may be made with the finger-ends; or again, the bleeding points may be touched with nitrate of silver or perchloride of iron. In cases where the hemorrhage is alarming, or the foregoing means have failed to arrest it, the soft parts beneath the bite may be transfixed by a fine needle, and a silk ligature may be wound around them beneath the needle-ends. In selecting a spot for the application of leeches, it may not be amiss to bear in mind the fact of the characteristic triradiate cicatrix left by the bite, and that this is indelible.

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[1] Leeches should not be applied to the upper eyelid.

Scarification is employed in various parts of the body, as a means of directly relieving the local congestions of free surfaces. The operation consists in making small incisions on the surface of the part with the point of a lancet or scalpel; these incisions varying in depth and extent with the texture of the part affected and the severity of the local mischief. They are employed in chemosis of the conjunctiva, phlegmonous inflammation of the integuments, acute engorgements of the tongue and tonsils, and in other parts.

Cupping in its most ordinary form consists in the local abstraction of blood from minute incisions by means of atmospheric pressure; cupping-glasses, a scarificator, and a spirit-lamp, are required for the performance of this operation. Cupping-glasses are of various forms and sizes, but, for the most part, narrow at their necks and somewhat dilated at the opposite extremity. [Ordinary wine- or egg-glasses answer perfectly well.] They are employed for creating a partial vacuum over that part of the surface from which the blood is abstracted; the air within them is rarefied by introducing for a second or two the flame of a spirit-lamp [or by burning a bit of paper in each one]; on the withdrawal of this, the open mouth of the glass is immediately applied to the part to be cupped. [Professional cuppers use a small pump adjusted to a tube let in at the closed extremity of the cups made for the special purpose.] This has the effect of producing great local congestion and swelling up of the parts included within the rim of the glass. The glass may be conveniently removed by tilting it to one side, and at the same time insinuating the point of the forefinger under its edge on the opposite side. The *scarificator* is used for simultaneously and quickly effecting the necessary incisions for the abstraction of blood; it is formed of a number of blades fixed on an axis, which latter by a rapid semirotary movement projects the blades through appropriate openings in the instrument, and divides the integument to the required depth. Before its application the blades of the scarificator should be set so as to cut through the cutis vera, but not to encroach upon the subcutaneous tissue; this being effected, the spring may be drawn back, and set, and the instrument being held pretty firmly in contact with the skin, the spring may be released.

Before the application of cupping-glasses the skin of the part should be sponged with warm water, and any hair there may be on the surface should be removed: a basin of warm water and a lighted candle should be at hand. The glasses being first placed in the warm water, should be applied, in the manner above mentioned, one by one to the part from which the blood is to be drawn; care being taken that sufficient intervals are left between the glasses: they may be allowed to remain in contact with the skin for about a minute; as each is withdrawn, the scarificator should be applied to the swollen integument beneath, and the glass should be as quickly as possible readjusted to the part. The blood will continue to flow from the incisions until the exhaustive power of the glass has ceased by the vacuum within being destroyed; when this occurs, the glass may be removed, and a fresh one may be applied to the same spot, the surface being first sponged to remove any coagula that may have formed. As each glass is removed, the blood from it may be emptied into a graduated vessel. When the required amount has been abstracted, the wounds may be sponged, dried, and each group covered with a piece of diachylon plaster.

It is often extremely difficult to procure the required amount of blood by means of cupping; and this, though it may occur from many causes, is chiefly owing to one of two reasons, namely, that either the depth of the incisions has not been rightly adapted to the thickness of the skin of the part, or that the vacuum within the glass is insufficient or too complete. To avoid both these evils requires some knowledge of the different thickness of the integument on various parts of the body, and a certain manual skill which can only be acquired by practice. When the skin has been too freely divided by the scarificator, the subcutaneous tissue is apt to bulge through the incisions in the skin and hinder the flow of blood, while the disadvantages of an insufficient division are obvious. Should the atmospheric pressure be so great as to constrict the cutaneous capillaries around the rim of the glass, this pressure may be relieved by rotating the glass a little, or by swaying it to and fro, so as to allow a little external air to get beneath its margin.

There remains to speak of another form of cupping, usually termed "dry cupping." The object of this is to abstract blood temporarily from one part of the body by detaining it for a time in other parts. To effect this, several cupping-glasses are applied and renewed at intervals, their position being slightly varied each time, so that the skin may not suffer from the pressure.

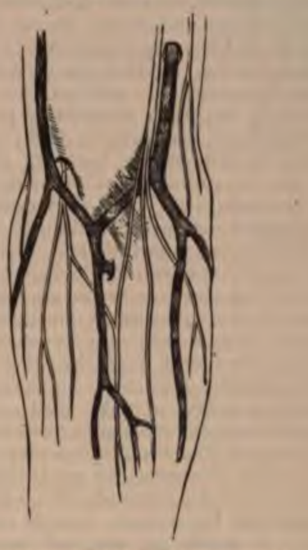
As a general rule, cupping-glasses should not be applied in the immediate neighborhood of inflamed tissues, nor over the mammary region. Their adjustment also is well-nigh impossible in certain situations, such as the perineum, or the anterior regions of the thorax in emaciated patients.

M. Junod has devised an instrument by which he considers that he produces a transient condition of general depletion. The apparatus consists of a metallic cylinder closed at one extremity, and sufficiently large to contain either the upper or lower limb; attached to the cylinder is a small stopcock, to which is fitted an exhausting syringe. One of the limbs is immersed in the metallic case, and a very wide India-rubber band being drawn over the open end and around the limb, so as to form an air-tight cavity, the syringe is applied until the condition of the pulse indicates that a sufficient amount of air has been removed. This proceeding is said to possess many of the advantages of general depletion without exercising any permanently debilitating effect on the constitution.[1]

General Bloodletting.

Venesection.—This operation may be performed upon the veins of the forearm or hand, the external jugular, the veins beneath the tongue, those of the scrotum, and the saphena, near the inner ankle. Whatever vein is opened, it is necessary, when practicable, to produce congestion of it, by compressing the vessel between the point to be opened and the heart. A lancet, bleeding-tape or narrow bandage, lint, a bowl to receive the blood, and a basin of water and a sponge, are required. The operation, as ordinarily performed in this country, consists in opening one of the veins at the bend of the elbow. Of these the most prominent are the median cephalic and the median basilic, the former being situated to the outer side of the tendon of the biceps, the latter to its inner side [fig. 913], and immediately over the course of the brachial artery, indeed only separated from the artery by the fascial attachment of the biceps muscle. For anatomical reasons, therefore, the median cephalic should be preferred for venesection; but in practice the more prominent and larger vein of the two is selected.

[Fig. 913.



Veins at the bend of the right arm (Gross).]

The patient being placed in the sitting posture, the bleeding-tape or bandage may be tied around the limb about the middle of the upper arm, sufficiently tight to arrest the venous circulation without affecting the pulse at the wrist. The forearm having been allowed to hang down until the veins are tense and turgid, the operator may select one for his purpose, and taking the blade of the lancet between the forefinger and thumb of his right hand, should fix the vein by pressing his left thumb upon it, just below the part he is about to open. Steadying his hand by resting the ends of the three inner fingers on the forearm, the point of the lancet may be introduced obliquely until the interior of the vein is reached and the blood rises up out of the wound; without penetrating any deeper, the lancet should now be thrust onwards, thus laying open the vein longitudinally, and cutting its way out in advance of the point of puncture. The vein being well opened, the thumb may be removed, and the blood allowed to flow; if the stream be scanty and sluggish, the ordinary expedient may be adopted, of directing the patient to clench his fist firmly from time to time, or the surgeon may chafe the veins on the palmar surface of the forearm, rubbing from below upward. When the required amount of blood has been abstracted, the thumb of the left hand may be placed over the wound, and the ligature around the arm relaxed; a small pad of lint being placed over the orifice in the vein, the parts around should be cleansed from blood, and the tape applied in a figure-of-eight fashion, so that the crossing of the tape lies over the pad on the vein and keeps it in place, exercising pretty firm pressure (F, fig. 892, p. 639). From a want of coincidence between the wound in the integuments and that in the coats of the vein, the blood may cease to flow altogether, or may continue to escape in a diminished stream; this is frequently caused by the wound having been made while the arm was in the supine position and by the subsequent pronation of the limb; it can generally be remedied by sliding the skin over the vein until the two wounds are made to coincide. In extreme cases of this kind, where the blood escapes into the surrounding cellular tissue, the swelling occurs to which the term thrombus is generally applied. This, if of considerable size, may be laid open with the lancet, though more generally it needs no surgical interference, but may be allowed to become absorbed. After the operation, the arm should be carried for a day or two in a sling.

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[1] In a case in which I had an opportunity of observing its effects, these were less marked in the constitution at large than in the limb itself; the latter seemed intensely congested, and on the removal of the instrument, was covered with minute cutaneous ecchymoses.

In children, and occasionally in others, where the subcutaneous veins at the bend of the elbow are ill-defined or of small size, venesection is practised on the external jugular. For this a pretty bulky pad of lint is required; it should be applied over the vein in the hollow just above the clavicle and external to the sterno-mastoid muscle, and should be secured by a bandage passed over it and fastened in the opposite axilla, so as to exercise firm pressure on the vein. The part of the vessel generally chosen for the operation is where it overlies and crosses the sterno-mastoid; the vein being fixed with the thumb of the left hand, the incision may be made in the same manner as in bleeding at the bend of the elbow, the line of the wound being parallel to the fibres of the sterno-mastoid muscle, so as to secure a transverse division of the platysma myoides. The blood can be directed into a bowl by means of a piece of cardboard folded in the form of a gutter, or it may be collected in a teacup held close below the wound. To arrest the bleeding, a pad must be applied over the wound, and retained by strips of plaster; the compress over the clavicle may then be removed. The possibility and the effect of the entrance of air into the vein during the foregoing operation, is too well known to require more than a passing caution, to see that the pad applied to the vein is thoroughly effectual in arresting the circulation, and to be careful not to remove this pad until after the orifice in the vein has been closed.

The saphena vein is but rarely opened for the purposes of venesection, in this country at least, though there are many Continental surgeons who consider it a more favorable vessel for the operation than the veins at the bend of the elbow. The venous current is in this case arrested by a bandage around the limb, just above the ankle; the vein is opened above the inner malleolus, and the bleeding is encouraged by immersing the foot in warm water.

The cutaneous veins of the scrotum may be advantageously opened in many cases of acute orchitis, the bleeding being encouraged by warm fomentations, and arrested when necessary by exposing the part to the external air or by the application of cold water. For the various mishaps and ill consequences of venesection and their appropriate treatment, the reader is referred to the essays on INJURIES AND DISEASES OF THE VEINS AND ARTERIES.

Arteriotomy.—The only vessel on which this operation is practised is the temporal artery itself, or one of its principal branches; the main trunk of the vessel may be found crossing the zygoma at right angles about half an inch in front of the pinna of the ear, and just above this spot the artery divides into its anterior and posterior branch. A small bistoury or a lancet, a narrow bandage, a small firm compress, sponge and water, and a bleeding-bowl, are required for this operation. The position of the anterior division of the vessel being ascertained, or that of the main trunk itself if the former be of insufficient size, its exact situation should be marked, and the vessel may be at the same time fixed by placing the forefinger or thumb upon it, just below the point where it is to be opened. The blood should be drawn from a transverse wound in the vessel, made by cutting down upon it with a bistoury, or with a lancet, by first puncturing its coats and then laying open its canal more freely. To arrest the hemorrhage the artery may be completely divided, the part sponged, the compress applied to the wound and secured by the knotted form of bandage (fig. 894, p. 640), This should be most carefully adjusted, so that it may remain undisturbed for four or five days, when it may be removed, and the wound covered with a strip or two of plaster.

VACCINATION.

In addition to the common lancets and ivory points, there are special instruments constructed for introducing vaccine lymph. Mr. Ceely, of Aylesbury, has invented a small arrow-head-shaped lancet, with a groove on one of its flat sides, for carrying the lymph. A small needle, grooved up to its point, is also made use of by others. A needle with an arrow-head-shaped point has been invented by Mr. Sprattey; this has a groove on one surface, and a small rectangular shoulder about a twelfth of an inch from the point. This instrument is fixed in a hollow ivory handle, within which capillary tubes containing lymph can be carried. Dr. Husband uses an instrument, invented by Dr. Weir, having a flat ivory handle fitted with a lancet at one end, and at the other four minute needle-points; by drawing these sharply over the surface the cutis is slightly abraded; two such scratches are made, and over these the lymph is gently rubbed. These scratches should be quite an inch apart, since lymph applied in this manner generally produces a group of confluent pustules. Vaccine lymph should be taken from the vesicle not later than the eighth day after inoculation. When fresh virus is to be applied directly from a mature vesicle, the patient's left arm should be grasped in the operator's left hand, just above the insertion of the deltoid muscle, and the skin on the outer aspect of the part put on the stretch. The lancet, being previously armed with the vaccine lymph, is held with the flat of its blade turned towards the surface, and is made to perforate the cuticle very obliquely, so that its point may separate the cuticle from the cutis to a small extent; this may be effected without causing any hemorrhage, or at most, not more than a drop of blood need escape. As it is withdrawn, the lancet may be pressed against the raw surface of the cutis, or the thumb of the left hand may be used to press the edges of the puncture together, so as to wipe the virus off the point; two or three such punctures should be made, each about an inch distant from the other, and any blood or serum exuding from them should be allowed to dry on the part.

Ivory points or slips of quill may be used to dip in the virus, and insert into punctures, instead of employing the lancet for this purpose. [These are very largely used at the present day in the United States, being supplied in any desired quantity by all city druggists, who obtain them from those who make it a business to prepare them with vaccine lymph. The lymph direct from the cow is much more irritating than the "humanized;" whether it is more efficient or not is perhaps a question. One reason of the popularity of this plan is the security ensured by it against the transmission of disease.] If dry lymph upon points be used, it must first be softened over the steam of hot water, or it may be moistened with warm water before its introduction; lymph between glass slides should be moistened and scraped off the glass with the lancet point, and thus applied. A very efficient but more painful method of vaccination is the plan of scratching off the cuticle with the lancet-point, and applying the virus to the denuded cutis.

Dr. William Husband, of Edinburgh,[1] has introduced and established a method by which vaccine lymph may be preserved for considerable periods of time, uninfluenced by changes of climate. This he effects by hermetically sealing it within capillary glass tubes; he recommends for the purpose such as are from two to four inches in length, and about $\frac{1}{28}$th of an inch in diameter, their walls being $\frac{1}{200}$th of an inch in thickness. The following are the directions given by Dr. Husband for charging these tubes:—

The vesicles having been opened with the lancet in the usual way, the tube, held horizontally, is charged by applying one end of it (the straight end if they be not both straight, not that which tapers to a point) to the exuding lymph, which enters immediately. As much lymph is allowed to enter as will fill from about one-seventh to one-half the length of the tube. As a general rule, each tube should not be charged with more than will suffice for one vaccination. It may be sealed in one or other of the following ways. In the first, the lymph is made to gravitate towards the middle, by holding the tube vertically, and if necessary giving it a few slight shocks by striking the wrist on the arm or table. The end by which the lymph entered may then be sealed, by applying it to the surface of the flame of a candle. The other end should first be plunged about half an inch into the flame, and as quickly withdrawn till it touches the surface, where it should be held till it melts over and is sealed. This precaution of plunging the tube into the flame before sealing it, is useful, in order to expel a portion of the air. Or the tube may be sealed thus: the lymph having been introduced at one end of the tube, is made to pass towards the opposite by exhausting the air at that end over the flame of a spirit-lamp; this end of the tube is then sealed. On cooling, the lymph will pass towards the middle of the tube; the orifice by which the lymph entered is then sealed, as in the first method. Not more than a minute or two should elapse between charging the tube with lymph and sealing it up, or the lymph will concrete at the orifice, and cannot then be forced into the centre of the tube.

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[1] Exposition of a Method of Preserving Vaccine Lymph fluid and active; with Hints for the more Efficient Performance of Public Vaccination. London: Churchill, 1859.

In order to obtain the lymph from a tube for the purpose of vaccination, the sealed ends are to be broken off, and the fluid contents blown out gently on the point of the lancet or vaccinating instrument.

The result of primary successful vaccination may be stated to be as follows: the puncture may be felt slightly elevated on the second day; on the third it is surrounded by a slight halo of redness; by the fifth a distinct vesicle will be formed, having a slightly elevated margin and a depressed centre; on the eighth day the vesicle should have reached its perfect condition, when it is pearl-colored, and distended with clear lymph, its margin being turgid, firm, and shining. From this period the redness around increases in extent and intensity until the tenth day, when there is often well-marked swelling, and induration of the subjacent cellular tissue. On the eleventh day the areola begins to subside, leaving as it fades two or three concentric rings of redness; the vesicle begins to dry up, assuming a brownish color; the remaining lymph becomes opaque, and gradually concretes, forming by the fourteenth or fifteenth day a dry reddish-brown scab; this contracts, dries, blackens, and finally falls off about the twenty-first day. The resulting cicatrix is permanent, slightly depressed, dotted, or minutely pitted.

When persons who have once been successfully vaccinated are some years afterwards re-vaccinated with effective lymph, vesicles occasionally result, which in their appearance and in the course they run cannot be distinguished from those produced by primary vaccination. Far more generally these results are variously modified; either no true vesicle forms, or it attains its maturity and runs its course with greater rapidity than the regular vesicle. The areolæ also tend to diffuse themselves more widely and less regularly than in primary vaccination, and the local changes are accompanied by much itching, often by some irritation of the axillary glands, and in some cases by considerable febrile disturbance supervening on the fourth or fifth day.

CAUSTICS.

The various substances used for destroying morbid growths or the tissues of the body by chemical agency are generally termed potential cauteries. They will briefly be noticed in order, according to the degree in which they exercise their disorganizing effects. And first, those substances which either from their want of caustic power or from the tardiness of their action are generally applied only to raw surfaces, though occasionally to mucous membranes. These are such as tannic acid, sulphate of copper, nitrate of silver, sulphate of zinc, acid nitrate of mercury, arsenical paste, the chlorides of antimony and of zinc.

Tannic acid, as a caustic agent, is but rarely used in surgery: applied in the form of powder to raw surfaces, it produces a thin layer of disorganized tissue.

Sulphate of copper exercises sufficient caustic activity to be employed for the destruction of warts and condylomata, of fungous and unhealthy granulations, or the secreting surfaces of cysts. To produce any considerable effect, the solid salt requires to be rubbed pretty firmly over the part to be cauterized, the surfaces being previously moistened if dry.

Nitrate of silver, as a caustic, is applied in a solid form or in a saturated solution; it is chiefly of use in checking exuberant granulations, in destroying the surfaces of unhealthy ulcers or secreting cysts, in stimulating flagging sores, in producing a superficial slough on the surface of poisoned wounds, thereby diminishing their absorbent power, or for destroying warts and small condylomatous growths. In the solid form this salt is applied either by lightly brushing it over the part, producing a thin scale of dead tissue, of a bluish-white color, turning to black; or by rubbing it firmly again and again over the surface, so as thoroughly to destroy the part to a more considerable depth. Dry surfaces should be slightly moistened, and very moist or suppurating surfaces require to be partially dried before this caustic is used. In solution nitrate of silver is applied with a camel's-hair brush or a small piece of sponge, the caustic effect being far less marked than when used in the solid form. Though possessing but limited power compared with many other substances, yet lunar caustic has the advantages of acting with great rapidity, of causing but little pain, and of producing but slight irritation or disturbance in the surrounding tissues.

Sulphate of zinc.—The introduction of this substance as a caustic is due to Sir J. Y. Simpson of Edinburgh, who recommends its use either in the form of finely

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[1] This description is taken from the account given in the instructions to public vaccinators by order of the Privy Council.

levigated powder, as a paste composed of one drachm of glycerine rubbed up with an ounce of the powder, or as an ointment made in the proportion of two drachms of lard to an ounce of the dried sulphate.

It is applicable to ulcerations of the os uteri, rodent and lupous sores, or indeed to almost any form of obstinate or inveterate ulceration. For destroying warts and condylomata, and the vascular growths about the female urethra, it is said to be most efficacious. Sir J. Y. Simpson states that used in the form of powder, paste, or ointment to an open or ulcerated surface, it quickly produces a slough corresponding in depth to the thickness of the superimposed layer of caustic. The slough is of a white color, and usually separates about the fifth day, leaving behind it (if the whole morbid tissue be removed) a red granulating, healthy, and rapidly cicatrizing wound. The disorganized tissues showing no tendency to decompose, but are firm and inodorous. This caustic will only act on ulcerated or abraded surfaces; where the epithelium therefore is entire, the part must be prepared for its application by the previous use of the nitric acid or some other of the stronger caustics. The pain produced by the sulphate of zinc is said to be less enduring than that caused by caustics generally, the local inflammation is very slight, and the eschar has been observed to separate in most cases about the fifth or sixth day. Among other advantages claimed for this substance by its distinguished inventor are, the facility with which it is applied, the rapidity of its action, and the certainty with which its effects can be localized, since it shows no tendency to deliquesce; nor does its disorganizing power exert any influence over the surrounding surface, provided the epithelial covering is entire.

Acid nitrate of mercury is a fluid form of caustic, owing its activity to the nitric acid in its composition; though less powerfully caustic than that acid, it is better fitted for application to certain parts, since it does not fume when exposed to the air. It is much in use for the destruction of lupous and rodent ulcers, and for the former of these it is a most convenient and efficacious application. The solution is best applied with a camel's-hair brush, the surface of the part being previously cleansed and dried: it is necessary to limit carefully the application to the diseased part, since the epithelial covering of the mucous or cutaneous surface affords an insufficient protection against the action of this caustic. It may be well to mention that cases of poisoning are recorded from the absorption of this substance applied as a caustic.

Arsenical paste.—The only active ingredient of this preparation is arsenious acid; this is diluted with various inert substances to the required extent. The arsenical paste most in use in this country is that first employed by Baron Dupuytren; it consists of a mixture of calomel and white arsenic, in the proportion of from six to ten parts, by weight, of the latter to a hundred of the former. This being made into a paste with mucilage or a little water, may be applied to the surface of the parts, either directly or spread on lint or a piece of blotting-paper. The efficacy of this caustic is undoubted in the treatment of lupous, rodent, and other intractable ulcers; but there exists the obvious objection to its use, that it cannot be employed on a surface of any considerable extent, on account of the danger of its absorption into the system. Indeed, a case is related in the practice of M. Roux where the application during a single night of a paste, containing four per cent. of arsenic, to a surface of little more than an inch in diameter proved fatal. Considerable and sometimes enduring pain follows its use, accompanied with no little irritation and inflammation of the surrounding parts, and the eschar is slow to separate. The arsenical paste is inert on surfaces protected by epithelium.

Terchloride of antimony, or butter of antimony as it is usually termed, is a substance possessing powerful caustic properties, though but little used in this country at the present day.

Butter of antimony is stated by Pereira to consist of a solution of the terchloride of the salt in hydrochloric acid; it is used for the destruction of syphilitic warts or condylomatous growths, and is recommended by Continental surgeons for application to poisoned wounds and the bites of rabid animals. The solution may be applied with a camel's-hair brush until a whitish slough is produced, when the surface of the part should be thoroughly washed to remove any remaining caustic.

Chloride of zinc forms the active ingredient of many of the most popular and effective caustics; mixed with variable proportions of flour it constitutes Canquoin's paste. It enters into the formation of Landolphi's caustic, combined with equal parts of the chlorides of antimony, bromine, and gold. More recently other adventurers have made use of the caustic properties of this salt, and by mixing it with pretended remedies for cancer have endeavored to impose on the public, and conceal the uselessness of their supposititious specifics.

Chloride of zinc may be used in the form of solution by mixing one part of Sir W. Burnett's solution with seven parts of water, or as a paste in the proportion of one part of the dry chloride to two, three, or four parts of flour or plaster-of-Paris.[1] It is employed to destroy ulcerated surfaces, or to remove solid growths of various kinds; it should not be applied to any but an ulcerated, abraded, or denuded surface, as its action upon the parts protected by their epithelial covering is both slow and extremely painful. The solution may be applied on pieces of lint cut rather smaller in extent than the intended slough. The paste may be spread on lint in a layer varying in thickness with the depth of the part to be destroyed; in mixing the paste, the chloride will generally absorb sufficient moisture from the atmosphere to render the addition of spirit unnecessary. This caustic takes some hours to produce its full effect; the pain it produces is considerable, but not so acute or enduring as that caused by arsenical paste.

The slough when formed is whitish, dry, and inodorous; there is little inflammation excited in surrounding tissues; and decomposition in the wound, if it previously existed, is at once arrested. Nor does the slough itself show any tendency to putrefy. A considerable advantage attached to the use of this caustic is the very contractile nature of the wound resulting from its application, a contractility which becomes evident some days even before the separation of the slough.

In attacking solid growths with the chloride, to save time in the subsequent progress of the case, it is usual after the first application, and so soon as the slough is fully formed, to make incisions through the dead parts; these being stuffed with shreds of lint dipped in the caustic solution, or smeared with the paste, may from time to time be deepened until the whole substance of the growth is destroyed.

Nitric, hydrochloric, and sulphuric acid, in a concentrated form, are the most powerful of the potential cauteries; their influence extends rapidly through the common integument of the body to the deeper textures; they will act upon any part of the surface to which they may be applied. In the liquid form no caustic is so suitable as one or other of the above named for destroying the surface of sloughing sores, or for the local treatment of hospital gangrene. Their effect on such a surface is decided, rapid, and, in the case of the monohydrated nitric acid, far less painful than is generally supposed: the resulting eschar separates quickly, and the surrounding inflammation is not excessive. In applying the strong acid to a sore, the surface of the part should be carefully dried, and the skin in the neighborhood protected by being smeared with oil or simple cerate; and a glass brush, or a piece of cotton-wool or lint tied on the end of a piece of wood, may be used to bring the acid in contact with the surface of the sore.

For application to the sound skin, the concentrated acids are somewhat too diffuse in their action: with a view to obviate this tendency, they are mixed with various inert substances, and made into the consistence of a paste; thus sulphuric acid is mixed with powdered sulphur, saffron, or sawdust, and in this form it is far more convenient and manageable for the purpose above mentioned. The use of sawdust for this purpose originated with Mr. Syme, who also devised a most ingenious plan for protecting the surrounding surface, a method that can be adopted with great advantage whenever caustic is applied to the unbroken skin.

Mr. Syme gives the following account of the method in question: "A solution of gutta-percha in chloroform is applied to the skin for some distance around the parts to be attacked; then a thick piece of the same material, with an aperture cut in it the requisite size, and softened by exposure to heat, is pressed firmly so as to adhere to the surface thus prepared; a thin piece is next glued around the edge of the opening, so that when supported by a stuffing of lint it may form a wall enclosing the diseased part. Concentrated sulphuric acid, with about an equal weight of sawdust stirred into it, until the mixture assumes a homogeneous consistence equal to that of thin porridge, is lastly applied, in quantity proportioned to the extent of thickness concerned."

In the course of ten or twelve hours a slough will have formed, presenting the "appearance of strongly compressed tow."

For destroying the integuments, or denuding the surface preparatory to the use of some of the less active forms of caustic, Mr. Syme's mixture of sawdust and acid is specially adapted, or the caustic potash may be employed in the same way. Caustic potash, however, has the disadvantage of diffusing itself rapidly among surrounding parts; for this reason, with a view to confine its action, it is generally mixed with quick-lime in the proportion of five of the former to six of the latter, forming the Vienna paste, a more manageable and more active preparation than the pure potash.

[Glacial acetic acid, chromic acid, and the ethylate of sodium, have also been employed as caustics for the removal of warts, nævi, and other growths from the skin. The manner of their use does not differ materially from that of the caustics above spoken of.]

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[1] This caustic, either in solution or in its solid form, may be advantageously mixed with the hydrochlorate of morphia, which in a measure diminishes the pain attending the application.

Cautérization en flèches.—In 1858, M. Maisonneuve drew the attention of the Académie des Sciences to a method of applying caustic for the destruction or enucleation of solid growths, and gave to his method the name at the heading of this paragraph. The caustic he employs for this purpose is a mixture of one part of chloride of zinc and three of flour, combined so as to form a thick paste. This being spread out into a flat cake, is cut into narrow lancet-shaped strips, or wedge-shaped pieces, of a suitable size; these are subsequently dried until they acquire sufficient consistence to be available for the purpose about to be described.

One plan of attacking a solid growth with this form of caustic is the following: the base of the tumor is surrounded at short intervals by radiating punctures, converging towards the centre and deepest part of the growth, and completely undermining the diseased tissues; these punctures are made with a double-edged scalpel, the flat of the blade being turned towards the surface of the surrounding skin, and each should be of sufficient size to admit of the introduction of one of the caustic arrows previously prepared; as each puncture is made, the caustic should be at once plunged into the track of the knife, and allowed to remain. In a period varying from ten to twenty days, the whole growth will generally separate, leaving a clean granulating wound.

In cases where the growth cannot be circumscribed in the manner above mentioned, but can only be approached from the surface, M. Maisonneuve plunges the "flèches" in parallel lines into all parts of the substance of the tumor; or again, when it is important to preserve the skin over the site of a tumor, one or more of the "flèches" may be introduced through a lateral puncture quite into the centre of the growth, the resulting slough being allowed to escape through the aperture of puncture.

As a more convenient and more ready form of caustic, Mr. Paget has recently made use of small lancet-shaped slips of wood dipped into fused chloride of zinc; these are more readily prepared, and far more easily introduced, than the flèches recommended by M. Maisonneuve. It is needless to do more than to remark that this plan of removing tumors by enucleation, which can only be required in exceptional cases, is an exceedingly painful process.

The actual cautery has already been alluded to in the consideration of counter-irritants: in its ordinary form it is but rarely used for other than its counter-irritant or styptic effects; but as the galvanic cautery, there are many and various purposes for which it may be advantageously employed.

The galvanic cautery.—This country is indebted to Mr. Marshall for the application of this most commodious and ingenious form of cautery; more recently Dr. Middeldorpff, of Breslau, has refined, and as it were perfected, the mechanical appliances of the process; to his monograph on the subject the reader is referred for a full account of the mechanism and surgery of the galvanic cautery.[1] The cautery in question possesses its chief superiority over the more usual form of actual cautery, in the easily regulated intensity and the duration of the temperature employed; in the facility with which its mechanical form can be suited to the external circumstances and other requirements of various parts of the body; in the intensity of the heat produced by the galvanic current, the rapidity with which this is communicated to the metal employed as a cautery, and the possibility of applying the heat subsequent to the introduction and proper adjustment of the instrument to the parts to be cauterized. It cannot but be regretted that the expense of the necessary appliances, and the cumbersome nature of the apparatus, tend to confine the use of this form of cautery to the exigencies of hospital practice. Besides the more obvious and general use of this remedy in the treatment of sinuses and fistulæ of almost every kind, and as a counter-irritant or styptic, Dr. Middeldorpff extols its efficacy in the treatment of stricture of the urethra; for removal of polypi, amputation of the penis and uvula, removal of the tonsils, and even suggests its application for the amputation of entire limbs; indeed he allots to the galvanic cautery a more extended sphere of action than any but its most ardent supporters could concede.

Platinum is the metal employed for localizing the heat of the galvanic current, and for transmitting it to the parts to be cauterized. In all Dr. Middeldorpff's instruments an apparatus is fixed in the handle worked by a small screw, by means of which the galvanic current can be established or broken at will.

In treating fistulæ by this method, a platinum wire may be introduced into the track of the sinus, and being subsequently connected by its ends with the opposite poles of the battery, the cauterization may be effected.

Dr. Middeldorpff has figured and described a very convenient and narrow-pointed platinum cautery, adapted to narrow sinuses or lacrymal fistulæ; in such cases he recommends the use of a small speculum to protect the surrounding parts. For the removal of tumors, polypi, and other outgrowing parts, a species of écraseur is provided; the chain in this instrument is replaced by platinum wire, which can be tightened at will by an apparatus attached to the handle. Again, for cauterizing strictures of the urethra, Dr. Middeldorpff has invented a species of catheter, containing a concealed platinum point, to be projected and heated by an arrangement connected with the handle of the instrument. As a counter-irritant there is no superiority attaching itself to the galvanic cautery above the ordinary forms of actual cautery; but such as prefer to employ it may find in the work referred to above a description and figure of a small porcelain cone surrounded by a spiral platinum wire, expressly intended for the formation of caustic issues.

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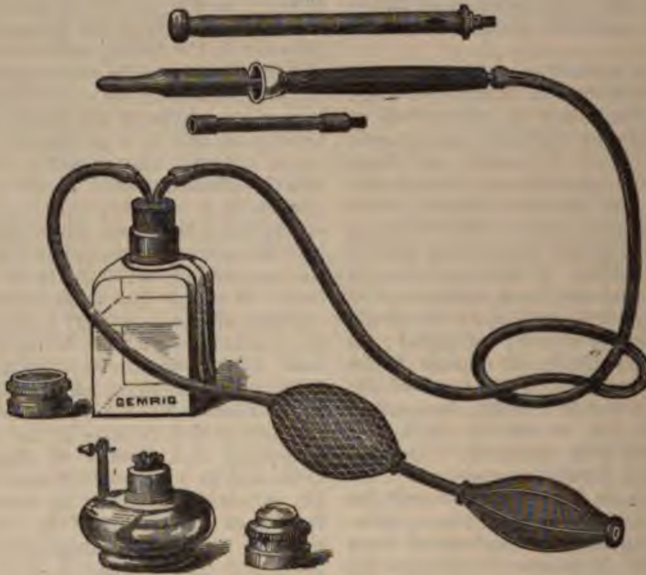
[1] Die Galvanocaustik, Breslau, 1854.

[Paquelin's thermo-cautery is an instrument largely used at the present time in various operations in surgery. It consists of a hollow handle, insulated with wood, and furnished with movable platinum heads, corresponding in form to the cautery-irons found generally useful, and some of them in the shape of knives; into these, which are hollow, after they have been heated to blackness in the flame of a spirit-lamp, benzoline vapor is introduced by means of an ordinary spray-bellows, and they are at once brought into a state of vivid incandescence, which can be maintained for any desired time by an occasional compression of the bellows (fig. 914).]

Fig. 914.



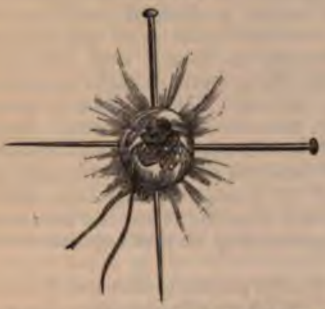
Paquelin's thermo-cautery.

STRANGULATION OF NÆVI AND OTHER TUMORS.

Nævi and some other small tumors may be strangulated by external or by subcutaneous ligatures. The most simple form of external ligature, and such as is well suited for small growths that are partly cutaneous and partly subcutaneous in their origin, consists in passing beneath the growth two fine hare-lip pins at right angles to each other. These should enter the skin clear of the nævous structure, and passing completely beneath its base, should emerge through the sound skin beyond; a piece of strong twine being wound around beneath the needle-ends, the growth may be strangulated and the whole secured by a double knot (fig. 915). For convenience, the needle-ends may be shortened, and a strip of lint may be wound beneath them to protect the surrounding skin, the whole being left to come away by sloughing. By some the needles are made use of only to raise the nævus during the tightening of the ligature; being withdrawn just before the knot is tied.

Again, a good plan, and efficacious for small nævi, recommended by Mr. Cooper Forster, is to tie the nævus upon the pins, withdraw them, and four or five hours afterwards to cut or untie the ligature. The crushing which the nævus or its vessels of supply undergo in this process leads to the wasting and shrivelling up of the growth, which separates in two or three weeks in the form of a dry, scabby lump; the resulting cicatrix is less considerable than that left by the ordinary plan of external ligature.

Fig. 915.



Strangulation of a nævus by two pins at right angles.

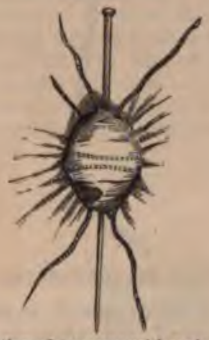
To lessen the pain of the ligature, and to hasten the separation of the slough, it is advisable to trace with the point of a small knife a groove in the skin in which the ligature may lie; this incision should run around the base of the nævus, connecting one needle-puncture with another. Some nævi, though of considerable size, are covered with sound skin, or a disproportionately small extent of this is affected. In strangulating such, before passing the ligature around the pins, a crucial incision may be made over the surface of the growth down to its base at the points where the pins pierce the integument; the four included flaps being reflected, the ligature is applied within them, so that after the separation of the slough they may in part at least, cover the denuded surface. It is probable, however, that nævi situated at such a depth beneath the surface and with the integuments so little affected as to admit of this proceeding being adopted, would be more suitably treated by injection or complete excision.

Subcutaneous ligature.—For the convenience of description, under this term all such ligatures will be described as are passed subcutaneously, either around the nævus or beneath it, whether completely or only partially beneath the skin.

The partially subcutaneous ligature, which is ordinarily in use for mixed nævi of large size, may be so arranged as to strangulate the growth (*a*) in halves, (*b*) in quarters, or (*c*) in as many portions as its size or shape may require.

(*a*) For strangulating a nævus in halves, a strong stout needle, or one fixed in a handle, with an eye at the point, being armed with a double thread, may be passed beneath the growth, so as to be quite clear of the nævous structure. The looped end of the twine being cut, the four ends may be grasped and used to raise the growth, while a pin is passed beneath it at right angles to the track of the ligature. The opposite ends of each portion of the ligature may now be tied together firmly beneath the end of the pin on the same side; the latter being shortened to a convenient length, the growth may be allowed to separate by sloughing (fig. 916), or the pin may merely be used to raise the nævus upon during the tightening of the knot, and be subsequently withdrawn. It is advisable to divide the skin around the nævus in the track of the ligature, just before drawing the latter tight.

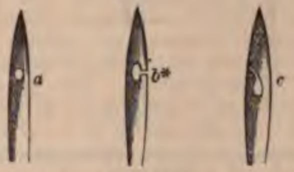
Fig. 916.



Strangulation of a nævus with a single pin.

For carrying ligatures beneath nævi, besides the common needle (fig. 917*a*) and that which has an eye opening and closing at will, shown in fig. 917*b* and fig. 918, there is a convenient needle with a slit in the side of the eye, closing with a spring, from which the thread can be disengaged by simply pulling on the loop (fig. 917*c*).

Fig. 917.



Strangulation needles.

(*b*) Of the plans in use for tying nævi in quarters, there are two of almost equal

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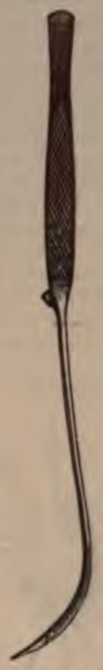
* The eye of the needle is here shown open.

Fig. 918.



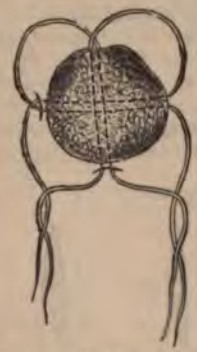
Needle with self-closing eye.

efficiency; the one introduced by Sir W. Fergusson, the other recommended by Mr. Cooper Forster. The latter gentleman uses a needle with an eye near the point, which opens at will, so as to disengage the thread by pushing a button attached to the handle (Fig. 918). The needle being thrust beneath the centre of the nævus, and out at the opposite side, the eye is opened, and the loop of a long and strong piece of twine is introduced, and retained by closing the slit in the side of the needle, which is withdrawn, bringing with it the double ligature, one end of which is divided, and the other, being carried a quarter of the way round the nævus, is thrust with the needle beneath the growth at right angles to its former course. This thread is now detached, and one end of the other thread is passed into the needle's eye and withdrawn with it beneath the nævus; the skin being divided to receive the ligature between the points of perforation, the four ends of the ligature may be tied together two and two.

Sir W. Fergusson makes use of a strong curved suture-needle, having a large eye. This being threaded on the middle of a long and strong piece of twine is passed beneath the nævus, the double thread being drawn half its length out on the opposite side; the loop is now divided on one side of the eye of the needle, and the opposite end of the thread that was cut is passed into the eye. These two ends are then carried with the needle beneath the nævus at right angles to the former course of the thread; the four free ends can then be tied two and two, the skin having been divided in the track of the ligature (Fig. 919).

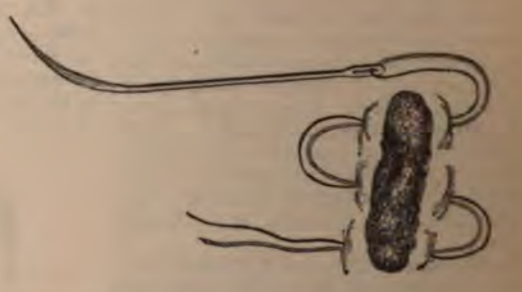
In addition to the proceedings above described, there is a method of strangulating a vascular tumor in four quarters, by passing beneath it at right angles two double threads in separate needles, and tying the eight ends together two and two in four knots. This plan is objectionable, as the thorough strangulation of the nævus depends upon the tying of the last two threads; when these are tightened, they frequently draw the knots of the other ends into the needle-holes in the integument, and thus prevent the complete strangulation of the growth.

Fig. 919.



Sir W. Fergusson's plan for subcutaneous ligation of large nævi.

Fig. 920.



Strangulation of large nævi with two differently colored threads.

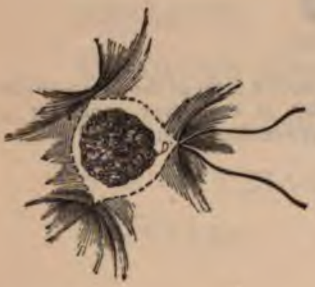
(*c*) The shape and size of a nævus, or the external conformation of the part upon which it is situated, may be such that the above-described ligatures are unsuitable for effecting its strangulation; for such cases, especially where the growth is of oblong form, a thread may be passed beneath the growth at suitable intervals, and the included portions be separately tied up. For this purpose, a long curved suture-needle may be threaded on the middle of a long piece of twine, one half of which has been previously dipped in ink, or otherwise colored. The needle may be passed beneath the growth at right angles to the long axis of this, at suitable intervals backwards and forwards, until the whole disease has been included between the threads. All the black loops of the twine on one side being cut, and all the white loops on the opposite side, each pair of white ends may be tied together on the one side, and on the opposite each pair of black ends (Fig. 920). If it be thought necessary, hare-lip pins may be used in conjunction with this suture, being passed at right angles to the course of the thread; they may be used either to raise the growth during the tightening of the knots, or they may be left *in situ* until sloughing takes place, to ensure that the ligature, in cutting its way through, shall pass completely beneath the disease.

Completely subcutaneous ligatures, when applied for the strangulation of vascular tumors, may be so arranged as to include the growth in (*a*) a single loop, or (*b*) in two portions.

(*a*) To strangulate a nævus with a subcutaneous ligature in a single loop. A strong curved needle carrying a stout ligature is passed into the cellular tissue, close to the nævus, and carried around the circumference of the disease as far as the needle will conveniently reach (of course the concave side of the curve of the needle should be turned towards the nævus in effecting this); the needle-point may then be protruded, and the ligature and needle drawn out, to be again introduced at the same hole, and carried onwards in the same direction, until the whole nævus has been surrounded, the needle being at last brought out at the point where it first pierced the skin (fig. 921).

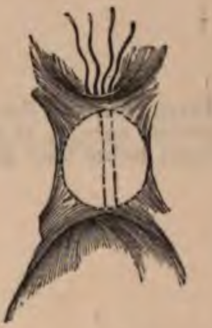
(*b*) To produce strangulation of a large nævus, it may be necessary to tie up each half separately; to effect this with a subcutaneous ligature, a double thread being carried beneath the base of the growth, the loop on one side of the eye of the needle may be divided, and each end of the thread be carried separately back beneath the skin, round the opposite semi-circumference of the growth; the needle being introduced at the former point of exit, and emerging where it first pierced the skin. The opposite ends of the same threads being tied together, the two halves of the nævus will be separately strangulated (fig. 922).

Fig. 921.



Subcutaneous ligation of a nævus entire.

Fig. 922

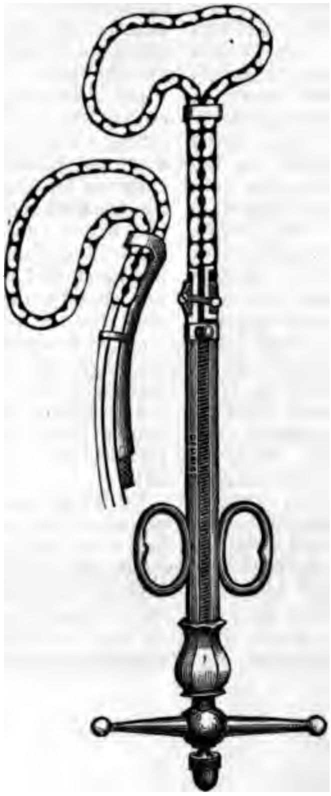


Subcutaneous ligation of a nævus in halves.

[USE OF THE ÉCRASEUR.

Mention has several times been made, in the foregoing pages of this work, of the écraseur, which may be used to advantage in many cases for the strangulation of hemorrhoidal or polypoid tumors, etc. The best form of the instrument is shown in fig. 923. In order to apply it, the morbid growth is isolated, if it has not a distinct pedicle, by means of two or more long metallic pins thrust through its base, as in fig. 915. If the growth is small, the loop of the chain may be easily thrown round it; if it is too large for this, one end of the chain must be detached for the purpose. Now by turning the handle, the instrument being steadied by means of the lateral rings, the central screw is also turned, and the loop very gradually tightened until it is brought home, when the tissues will be found divided. Very little

Fig. 923.



Écraseur.

hemorrhage follows, if the tightening has been gradual enough, as the vessels are compressed before they give way. The curved form of the écraseur shown on th left is that very generally preferred i gynæcological surgery.]

PART VI.

MISCELLANEOUS SUBJECTS.

DISEASES OF THE BREAST.
[DISEASES OF THE SKIN.]
PARASITES.
VENOMOUS INSECTS.
SURGICAL DISEASES OF CHILDHOOD.
SURGICAL DIAGNOSIS.
HOSPITALS.

PART VI.

MISCELLANEOUS SUBJECTS.

DISEASES OF THE BREAST.

By J. Birkett, Esq.

Revised by Theodore A. McGraw, M.D.

The surgeon who desires to discriminate accurately between the different diseases of the breast, and wishes to assist the efforts of nature in their cure, must never be unmindful of the physiological peculiarities of that organ, and the important function which it performs in the animal economy. Closely associated through the medium of the nervous system with the pelvic procreative organs, the breasts are intimately combined with them in the performance of their healthy functions, and are not less peculiarly sensitive to, and speedily influenced by, their morbid states.

Hence it is necessary to preface this essay with a few general remarks: 1st, on the anatomy of the gland at different periods of life, and under precise physiological conditions; for the brevity of which the required limitation as regards space must be pleaded as an excuse; 2dly, we shall refer to some of the more important points in relation to the diagnosis of the diseases; and lastly, to their treatment.

General Observations.

Anatomy. — Unlike most organs of the body, this gland maintains a perfectly rudimentary state for several years after birth, until, like the others belonging to the functions of procreation, its development advances sympathetically and synchronously with the ovaries and uterus, at a certain definite climacteric, termed the age of puberty. Even in both the sexes changes in this organ then take place. In the male, after slight temporary excitement, the action subsides, and a state of repose is maintained by it throughout the remainder of life, with rare exceptions. But in the female the rudimentary organ of the infant and of the child becomes developed into a gland at puberty, when a state of passive maturity only is attained. Still further changes are excited by the stimulus of conception, to convert it into the source of nourishment for the offspring; when, in this its most perfect state, it becomes an active organ, a secreting gland. Yet this is but a transient condition. For in the healthy state of the organ, it continues only as long as the stimulus to the activity of its function is applied; it immediately ceases when that is removed. It now resumes a state of repose, to be, nevertheless, excited to a repetition of its function as the stimulus arises. When, however, the demand for its functional activity is withheld, or the period of life is reached when the functions of the procreative organs become extinct, this gland also becomes wasted, and the process expressed by the term "involution" takes place, or, in other words, atrophy occurs. It must be likewise remembered, that at every catamenial period more or less temporary sympathetic actions are excited in this organ.

In the human subject the normal number of the breasts is two. Deviations from this rarely occur, but one or both may be absent (*amazia*); and cases of plurality, or excess of the usual number (*pleiomazia*), are recorded. The breasts are placed on the antero-lateral regions of the thorax, and occupy more or less superficial extent in different individuals. Hence they are termed pectoral. They are interposed between the integument with the subcutaneous fat and the great pectoral muscles, beneath the inferior and axillary border of which a portion of the glandular tissue often extends. They are held in their position by fibrous bands, which extend from the integuments to the fascia of the pectoral muscle, between the separate masses of glandular tissue; these are the suspensory ligaments of Sir A. Cooper.

Examples are recorded in which glands secreting milk, supplementary to the normal breasts, have existed on the thorax, in the axilla, on the back, the abdomen, and in the groin. The shape of the breast varies considerably at different ages, under its changeable functional states, and in different individuals, in relation to their peculiarities of nutrition. Considered as a mass of glandular tissue, the shape of the whole body is hemispherical, the convex surface being in immediate relation with the integuments. The whole organ is constituted of a variable number of individual masses, each one having its separate excretory duct or lactiferous tube. These are again and again divisible into the lobes and the terminal lobules, in which are observed the acini, composed of the cæcal terminations of the ducts. The lactiferous tubes commence in these cæci, and the minute ducts unite and unite until a single canal is formed, which, after dilating before it reaches the nipple (the reservoir of Sir A. Cooper, or sinus lacteus), terminates in an open mouth thereupon. Every acinus, lobule, and separate lobe possesses a delicate fibrous envelope, and all are united together by means of the ordinary connective tissue which abounds in this organ. That segment of the breast nearest to the axillary and abdominal regions of the body is the largest. The fossa or sinus between the breasts is called the bosom. The *nipple* is that division of the gland to which all the ducts converge, which projects upon its surface, and is surrounded by a dark circle of skin called the *areola*. It is composed of a large quantity of contractile fibre-tissue, as well as connective, through which the milk-tubes pass to terminate in open mouths upon its apex, between the superficial rugæ of its cutis. Beneath the skin of the areola numerous sebaceous glands are usually distinctly visible, but not constantly.

The mammary organ undergoes great changes at different periods of life. In infancy, it is but rudimentary, and although it enlarges and even secretes milk a few days after birth, it is not until the age of puberty that the glandular tissue is really developed in any quantity. At this time remarkable structural changes occur, and in a few months the growth of the organ is complete. But even then it is only perfect to a certain point. After puberty we therefore recognize two conditions: a state of inactivity or repose, passive maturity; and a condition in which the function of the gland is actively performed, when milk is secreted. At a subsequent period the tissue of the gland generally becomes atrophied, and fat occupies the place of the gland-tissue. The ducts, however, are persistent. Associated with these different states there are certain diseases requiring to be specially noticed. It therefore behooves the surgeon to take cognizance of them in all cases of disease, the nature of which he may be required to discover.

Whilst investigating the development and structure of the breast, it is essential to bear in mind the two parts into which every secreting gland is divisible; that is to say, those structures within which the secretion is formed, and the tubes along which it flows away; or, in other words, the secreting portion of the organ, and the excretory ducts. The progressive development of this gland takes place very slowly, and is intimately associated with certain definite periods in the life of the female. We shall therefore describe its condition at birth and before puberty; at puberty and subsequent to that period; after uterine conception, after parturition, and during lactation.[1]

[The general acceptance by the German school of pathologists of Remak's theory that epithelial tumors can spring only from cells originating in the external and internal blastodermic layers, and connective-tissue tumors only from those of the mesoblast, makes it necessary to say a few words regarding the development of the mammary gland. It has hitherto been regarded as arising from the corneal germinal plate by the growth of its cells inward. Within the last three years, this generally accepted theory has been disputed by Mr. Creighton, who, after careful study of the development of the fat body underlying the mamma in kittens, and of the mammary glands of guinea-pigs, has advanced the opinion that the acini arise from the kind of embryonic cells which give origin to the surrounding fat-tissue, and that the ducts grow from the same matrix by the direct aggregation of cells along predetermined lines. The importtance of this statement, if once established, will appear when the question is considered of the histogenesis and nature of tumors.]

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[1] The reader, desirous to peruse a more detailed and minute description of the physiological anatomy of the breast-gland than the writer is permitted to introduce into this essay on its diseases, may refer to The Anatomy of the Breast, by Sir Astley Cooper, 1840; Ueber d. Bau. u. d. Entwicklung d. Milchdrüse bei beiden Geschlechtern, von Dr. Carl Langer, Wien, 1851; Mikroskopische Anat., oder Gewelbelehre d. Menschen, von Dr. A. Kölliker, b. ii., p. 467, 1854; or the translation of Kölliker's Manual of Histology, published by the Sydenham Society, vol. ii., p. 272. Also an article entitled "Pathologische Anat. d. Brustdrüse, von Dr. H. Meckel," in the Illustrirte Med. Zeitung, von G. Rübner,, b. i., 1852, p. 141. Stricker, Handb. d. Lehre v. d. Geweben, Leipzig, 1870.

1. *Anatomy and diseases of the rudimentary organ at birth and before puberty.*—Before birth, soon afterward, and to the age of pubescence, the glandular element consists of the excretory ducts only, in a more or less rudimentary state, imbedded in a fibrous stroma. In their earliest condition they are not even tubular, but solid, and are composed of an aggregation of nucleated cells terminating in clavate ends. Each duct radiates from the nipple towards the periphery, by gemmation becomes more and more branched, and, by slow degrees, a tube. Before birth the nipple is represented by a slight depression. Here we may observe that in many of the *adenoid growths*, to be hereafter described, the structures resembling those above mentioned are seen, and they are probably identical. Also that this rudimentary state of the nipple sometimes remains persistent throughout life. Soon after birth, in both sexes, the rudimentary organ becomes swollen and tender, at which time a little secretion sometimes escapes from the nipple, which, of course, is extremely minute. A well-marked hardness may be felt, which, when pressed, causes pain. By the officious interference of nurses, this excited organ is often inflamed when they use rough and frequent frictions to "rub away the milk." If this rudimentary organ be examined after death at this moment, it shows remarkable vascular congestion.[1]

2. *At puberty*, and especially after the appearance of the catamenia, the secreting portion of the organ becomes developed. This consists of the cæci or true terminal gland-vesicles, which are first perfected at the borders of the gland only, causing when touched a sensation as of minute granules subcutaneously seated. These terminal vesicles are formed of a structureless membrane. They are connected with the terminal branches of the ducts, and are externally covered by a network of capillaries. Their contents are oval and flattened nucleated cells. The breast having reached a state of passive maturity does not appear to be divided into individual masses, and the surface of its section is therefore perfectly smooth, homogeneous, and of an opaque yellowish-white tint. But a gland by which milk has been once secreted shows the separate masses of which it is composed much more distinctly, as the connective tissue unites them together less firmly. The ducts in the peripheral portions of the gland are always in a more advanced state of development than those in the centre, in the virgin as well as in the puerpera. The stroma of the breast consists of fibre-tissue in large proportions. It is chiefly filamentous and wavy; but intermixed with it is that variety so abundantly met with in the contractile membranes. Doubtless this tissue preserves the form of the organ, as well as assists in compression of the milk-tubes. Besides these tissues we see a well-defined fascia or membrane investing the most minute divisions of the gland-structure, its lobules and lobes. A double outline is thus produced bounding the cæci.

In the adenoid growths developed in the breasts of girls and young maidens, we meet with structures identical with those above described. Many of those tumors are, indeed, absolutely extra growths of the tissues composing the breast, and in some instances of even single and married women, the new growth attains to the perfection of the normal gland and secretes milk.[1]

At puberty the development of the breast advances rapidly in healthy girls. In males it is often attended with pain, which lasts but a few days, and then subsides. Occasionally, however, the region becomes much swelled, the integuments around the areola pink or red, with a conical prominence of the nipple and enlargement of the areolar sebaceous glands. When this excited action has somewhat subsided, a little serous discharge sometimes oozes out of the ducts on the nipple. Usually youths take little notice of these changes; but now and then, either from alarm at the occurrence, or from pain attending the pressure of the dress or manipulation of the part, the advice of the surgeon is asked. The age of the patient in whom the complaint occurs is the best aid in diagnosis. The removal of every cause of irritation, the application of moisture, if the part be red, enjoining repose, and attention to the general health, suffice to remedy the trouble. Should abscess occur, it must be treated *secundem artem*. Permanent enlargement of this gland is sometimes met with in delicate men, either on one or both sides. It is termed *gynæcomazia*.

In the female the progressive development of the gland generally advances in both breasts simultaneously, unassociated with local or constitutional disturbance. On the other hand, some girls show the anomaly of unsymmetrical development, that is, one breast enlarges and reaches a considerable size before the other makes any advance toward development. The age at which this strange defect takes place, concomitant with other phenomena of girlhood life, should guide the surgeon to a correct diagnostication of its nature. After reassuring the patient and her friends, the rest may be left to nature. Usually the commencement of mammary development precedes the first catamenial period; and if the breasts should sympathize with any morbid state of the ovarian functions, suitable medical treatment is indicated. It is a matter of considerable importance that, in order to favor the healthy development of the breast, the pressure of the dress against the growing organ should be studiously avoided.

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[1] On the secretion of milk in new-born infants, see an interesting paper by Natalis Guillot, read before the Academy of Sciences in Paris in October, 1853; or a translation in Edinb. Monthly Journal of Med. Science, February, 1854.

[1] See cases in Guy's Hospital Reports, 1855: Adenocele, case 1, with a lithograph, and case 2. Since the publication of those cases, the writer has met with others.

The nipple and areola.—The nipple is composed of the ducts united together by connective tissue, with bloodvessels, lymphatics, and nerves. These are all covered by skin, upon the surface of which, and beneath the cuticle, lies a layer of pigment cells. To this the color of the organ, as well as that of the areola, is due. The shade of brown varies from a light to a darker hue, according to the complexion of the individual and the active or passive state of the gland itself. The connective tissue contains a large quantity of the contractile fibre, which when excited to contract by any local irritation, or even mental emotion, produces a rigidity of the whole organ, which has been termed erection. There is not, however, a trace of true erectile tissue to be seen in it; the capillary bloodvessels are numerous and looped, and they may become congested; the milk-tubes may likewise be turgid and distended, as occurs during lactation; but the prominence and rigidity of the nipple, occurring in the virgin or married woman, is really only attributable to the existence of the contractile tissue, a layer of which exists also beneath the cutis of the nipple and areola, and produces the peculiar corrugation of that dark circle of integument. If looked for, it will be seen that the *cutis anserina* of the surrounding integument usually accompanies the condition of the nipple above alluded to. Covered by the skin of the areola are the lacteal sinuses. Here the ducts dilate before entering the nipple. Within that organ they are again contracted, and where they traverse the cutis each tube is extremely fine. Their open mouths are protected between the rugæ of the cutis; for the terminal boundary of the nipple is somewhat flattened and rugous. In these furrows small ulcers are frequently formed, and the secretions of the minute follicular glands and of the ducts, when allowed to accumulate, cause considerable irritation and inconvenience. The contractile fibres in the apex of the nipple may subserve the important purpose of preventing the constant flow and escape of the milk from the ducts. The validity of this statement can be tested by examining the nipple when its ducts are distended and the outlines visible near its root or beneath the areola. But as soon as the warmth of the infant's mouth induces a relaxed state of these fibres, the mouths of the ducts are no longer compressed, and the milk flows freely.

The glands of the areola.—Within the area of the areola are situated hair-follicles and sebaceous glands; the latter are often arranged with considerable regularity, especially a circle of them, smaller than the others, near its periphery. The large sebaceous glands elevate the delicate cutis of the areola, beneath which there is always an absence of fat. Hence sebaceous tumors are occasionally developed in this region. Hairs are rarely developed, except as age advances, or as correlative with a somewhat masculine development, or tendency to hairiness generally.

The nipple also becomes somewhat further developed at puberty in the female. It forms with the areola a conical elevation of the skin, having a bluish or pinkish tint; but it does not project much until a later period of life, often never at all in unmarried women. The size of this organ varies exceedingly in prolific women as well as in sterile; for, even in those who have suckled large families, its size often bears no proportion to the use made of it. In shape, too, it is very variable. Sometimes it is bifid at the extremity, and even two nipples have been seen on one breast. Anomalies in number and position occur in both sexes. But the most serious deformities affecting this organ are those where the development of its projection is arrested and it continues flat; or when, worse still, a depression or hollow only exists, in which the milk-tubes terminate. Very rarely, a duct opens on the areola, not as the result of disease, but as a congenital imperfection.

Cases of precocious development of the breasts are recorded.[1]

3. *After the complete establishment of puberty; after uterine conception; after parturition, and during lactation.*—The only normal changes in the female breast which occur irrespective of conception are slight enlargement, attended with more

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[1] London Journal of Medicine, vol. i., p. 85; Gaz. Méd. de Paris, 1834, p. 881.

or less pain, according to the susceptibilities of individuals, at each catamenial period, and a slight change in form and consistence soon after congression with the other sex. The nipple, areola, and its glands, show great changes, as respects form and color, under these circumstances, as well as after much handling and uterine conception; but it would be foreign to our purpose to enlarge upon them.

The changes of most importance affecting this organ are excited by conception. Now it is that its peculiar function to secrete food for the nourishment of the offspring is about to be performed; and from month to month, simultaneously with the development of the fœtus, alterations in the condition of the breast are observable. These changes are most easily watched in women having small glands; for in such the secreting portion of the organ would seem to disappear almost entirely after the cessation of lactation; whilst in those whose breasts remain permanently large throughout life the structural changes are not so easily detected. Nor does the size of the organ bear any just proportion to the perfect performance of its function; for as a rule, large breasts do not secrete so freely as small ones; and generally, when the milk is abundant, it is very poor in its nutritious qualities. Neither are its dimensions always in relation to the constitutional nutrition of the woman. For we often see strumous, cachectic girls with largely developed mammæ, whilst healthy, well-nourished maidens offer the opposite condition. It is probable that sexual impulse determines to a certain extent, the growth of these organs. And further it should be recollected that bulkiness is not always due to excess of gland-tissue, but to a growth of fat.

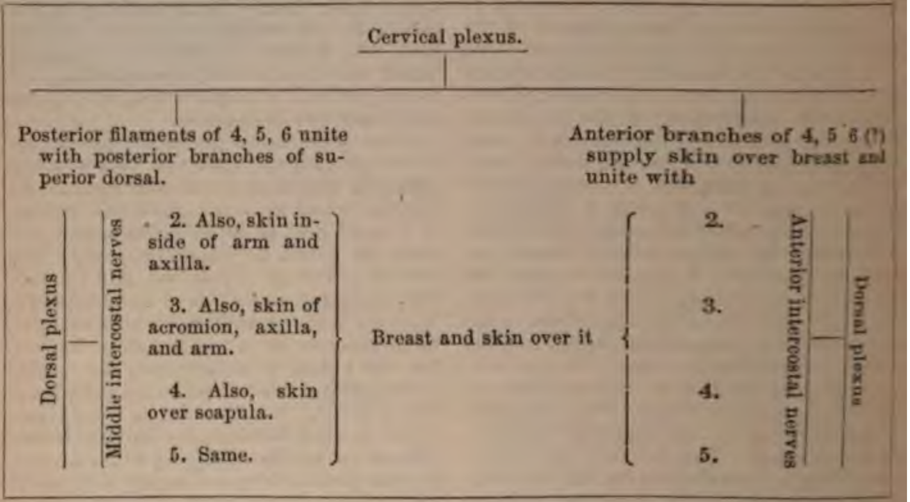
Where the gland-tissue has arrived at *the stage of passive maturity*, after puberty, the secreting portion of the organ can be very clearly seen, in consequence of the cæcal terminations of the ducts containing more or less epithelium. In addition to the gland-tissue, there is usually some fat diffused throughout the stroma in small lobules. The adipose tissue is more abundantly developed around the borders of the whole gland and upon its anterior surface; but it is rarely found between it and the pectoral muscle. As years pass on, however, when the breast has never been excited to the performance of its peculiar function, the cæcal terminations of the ducts are with difficulty detected, and the entire mass of the organ seems to be composed of fibre-tissue, fat, and ducts only. But at any moment the stimulus of excitement, reflected from the pelvic generative organs, may give rise to a certain amount of activity in the cæcal ends of the ducts, which become congested with epithelium, and thereby is produced more or less general enlargement and induration of the whole breast. When, as commonly happens, the stimulus excites a single mass or a lobe, or even separate lobules, the swelling and irregularity to the touch produced thereby, causes misapprehension that a new growth is developed. Such, however, is not a fact. We have to deal in such cases with a morbid state of the true gland-tissue, not with something superadded to the normal organ — a distinction not without a difference, for it is based upon structural peculiarities, and is of paramount importance as regards the treatment of the case.

After uterine conception the breast becomes at first full and firm, when small granular bodies may be felt around its periphery and upon its cutaneous surface. If a section of it be made in about the third or fourth month of pregnancy, the tint of its tissues is pale red, and the surface irregular, especially at the periphery; it is no longer a uniform white, opaque, homogeneous mass; although in its centre the changes are only just perceptible in comparison with those at the periphery. The vascularity of the organ is also one of its marked features, for minute blood-vessels are visible ramifying in its tissues. In the passive organ scarcely a vessel is noticeable. If one of the minute granular bodies (a gland acinus) be removed and its tissues carefully separated with needles, the cæcal terminations of the ducts are distinctly seen by the aid of a microscope. The addition of a drop of dilute acetic acid favors the observation of this object. The limiting membrane, or tunica propria, of the terminal gland-vesicles or cæci encloses more or less epithelium, the separate elements of which are oval and nucleated. In the centre of the breast the stroma shows a curious reticulated structure, in the meshes of which the writer is inclined to believe the acini are subsequently developed. At a later period of uterine conception the cæci are in greater abundance, and contain colostrum-corpuscles in addition to the epithelium.

After parturition and during lactation the surface of a section of the breast is deeply divided into lobes and lobules, and the acini are very distinct. It closely resembles the cut surface of a parotid gland or a pancreas. The cæci are filled with epithelium, which also contain the cells bearing the fatty globules found in milk. The breast has now attained its state of active perfection.

Such is a brief description of the metamorphosis of the inactive organ into an active secreting gland. In the perfection or imperfection of the changes taking place in the secreting portion of the glandular tissue we may seek an explanation of those cases, rare though they be, in which no sympathy seems to exist between the breast and the gravid uterus, and of others in which milk is never formed. In the first defect, when there is not any change during pregnancy, the cæcal terminations of the ducts are not developed, therefore the cells cannot be generated in which the fatty particles of milk are formed; and in the second, although the gland-vesicles may be complete, yet the epithelium is not perfected, and the milk-globules are absent.

Innervation.—The following scheme demonstrates the distribution of the spinal nerve-filaments to the skin over the breast, to the gland itself, and their associations with the cutaneous filaments of the contiguous regions.


Cervical plexus.
Posterior filaments of 4, 5, 6 unite with posterior branches of superior dorsal.
Anterior branches of 4, 5 6 (?) supply skin over breast and unite with
Dorsal plexus
Middle intercostal nerves
2. Also, skin inside of arm and axilla.
3. Also, skin of acromion, axilla, and arm.
4. Also, skin over scapula.
5. Same.
Breast and skin over it
2.
3.
4.
5.
Anterior intercostal nerves
Dorsal plexus

It should be thus read. The breast and the skin covering it are supplied by filaments from the anterior branches of the 4th and 5th cervical nerves. Filaments from the posterior branches of the same nerves join with others from the superior dorsal nerves. Filaments from the middle and anterior intercostal branches of the anterior division of the 2d, 3d, 4th, and 5th nerves of the dorsal plexus supply the breast and skin over it chiefly. A minute examination demonstrates the association between the 2d intercostal and filaments supplying the skin of the inside of the arm and axilla; also the same parts and the skin about the shoulder from the 3d; and the skin about the scapula from the 4th and 5th. These nervous intercommunications explain the widely extended pain of which patients so grievously complain when affected with mammary hyperæsthesia.

The arteries and veins.—The 2d, 3d, 4th, and 5th intercostal branches of the internal mammary artery usually convey blood to the sternal segment of the breast; within the axillary portion a large branch from the artery of that name very commonly ramifies; and the inferior and lateral regions receive a few branches from the intercostal vessels, which pass with the nerves through the middle intercostal foramina. As the nerve-filaments accompany the arteries, it is necessary to be careful to avoid embracing them in ligatures if used to arrest bleeding. This precaution is now no longer called for, as the writer has found that torsion of the arteries suffices to arrest hemorrhage.

The veins usually accompany the arteries, and terminate in the internal mammary and axillary trunks. A peculiar arrangement of the subcutaneous veins around the areola has received the name of *circulus venosus areolæ* (Halleri). The superficial veins are often dilated in those cases in which tumors are developed in the breast. This morbid condition seems to arise partly from their pressure, the interruption to the flow of blood, and probably to the increased quantity circulating through the growth.

The superficial lymphatic vessels terminate in the axillary, the cervical, and anterior mediastinal glands; a deeper series pass over and beneath the pectoralis major muscle to the glands placed under the clavicle.

General observations relating to the diagnostication of the diseases of the breast.—The diagnostication of the diseases of the breast is considerably assisted by ascertaining the age of the patient at the time of the development of the growth and its relation to the state of passive maturity or functional activity of the gland. The surgeon should ascertain the social position of the patient and her temperament; observe the condition of her nutrition, and especially whether, in relation to her actual age, she shows a youthful or aged aspect. The functional powers and derangements of the pelvic generative organs must be ascertained with precision, and in relation with them the state of the breast should be compared, as well as that of one breast with the other. Discharges from the nipple, its ordinary development, and any deviations from a normal condition, are important subjects, and should elicit inquiries relating to congenital or acquired defects. Uneasiness; temporary, transient, or persistent pain should be traced in certain defined directions with anatomical precision; and the intimate association between the nerves of the gland and the neighboring plexuses cannot be too carefully remembered. The lymphatic vessels and the glands in the axilla should never be overlooked; and even a wider range of observation, comprehending those above the clavicle and in the anterior mediastinum, must be taken. Having carefully obtained a knowledge of the facts above alluded to, the surgeon has then to determine whether the disease under observation involves the normal tissues composing the organ, or whether there be a new growth.

The age of the patient should be carefully ascertained, with the view to discover the period of life at which the disease was first observed; *e. g.*, by deducting the age of a new growth from the actual age of the patient at the moment of observation. That inquiry enables the surgeon to determine whether the existing affection is associated with the development of the gland; its state of maturity; or a condition of repose and atrophy. Also the actual age being known, the surgeon is enabled to decide whether the patient shows signs of premature age, a fact often of great moment in deciding on cases of carcinoma.

The social relations of the patient, whether living a life of excitement, celibacy, or the contrary; if married, whether prolific or sterile; and if prolific, whether the uterus has performed its functions in a healthy manner or not, are facts to be noted, several of its morbid states being closely connected with the secondary influence of social conditions, as the indurations of the gland-tissue in unmarried women, or in others who, although married, are yet sterile. Again, the activity of this organ, sympathizing as it does with the functional changes occurring in the uterus, is excited to increase of growth in preparation for the performance of its functions; and such normal increase in bulk might be mistaken for a morbid process, unless the actual social relations of the individual be conclusively established. Nor should the habits, occupation, and possible moral depravity of the sufferer be wholly neglected; for indulgence in vicious propensities doubtless exerts a secondary influence on the mammary organs: such as illicit intercourse with the male sex, intemperance, indulgence in spirituous liquors, unnatural sexual excitement, and constitutional syphilis. A strange perversion of the moral feelings occasionally exists which incites to the production of factitious disease in this part.

Observing the temperament of the patient sometimes assists in distinguishing the nature of the morbid affection: *e. g.*, in girls of an excitable nervous disposition, the gland is frequently exquisitely sensitive without being absolutely diseased, and some even describe an intensity of suffering and misery wholly incompatible with tangible local symptoms. A state of hyperæsthesia exists, purely, free from organic morbid processes.

The healthy nutrition and youthful aspect of one sufferer, as well as the cachectic care-worn look of another, both perhaps of the same age, are useful facts to aid diagnosis, although they must not be allowed paramount influence in every case. Thus, in a girlish, healthy-looking woman, a growth in the breast, however large, may be pronounced innocent, almost with certainty; whilst in another the anxious mien and aged facial aspect, the result of constitutional dyscrasia, may excite the suspicion of carcinoma. Caution must always be exercised in those instances in which the local disease, although physiologically innocuous to the constitution, may have excited much mental distress and bodily suffering in consequence of its condition during progressive stages of growth.

An inquiry into the state of the functional products of the generative organs should never be neglected, especially as regards the catamenia. The opposite conditions of excess and deficiency of the menstrual flux incite to sympathetic processes in the breast, and a certain class of its diseases are probably dependent entirely thereon.

When any disease occurs in the breast of a child-bearing woman, the capability of its functional powers should be ascertained; and if from any decided cause its secretion happens to have been interrupted or arrested, an attempt should be made to associate the existing disease with the active state of the gland. It frequently happens in such cases, whether associated with deformed nipple or not, that disease appears even many months after lactation has ceased, generally assuming the form of chronic abscess. This affection, however, is most common when the nipple has not been perfectly developed. In an imperfect state of the nipple, we have a fruitful source of trouble, and the natural conformation of the body of the organ, as well as of the nipple, prior to the discovery of any disease, should be carefully ascertained in every case especially under observation.

A knowledge of the manner in which lactation may have been performed by the two glands comparatively; the number of times that function has been excited and its duration, together with the diseases occurring during those periods, often aids the diagnostication of a disease existing a considerable period of time after the cessation of suckling, and which may be even intimately connected with some irregularity occurring at that time.

Without putting a leading question, the surgeon should ask the patient to describe the sensation or pain felt in the part; but he must be somewhat on his guard against implicitly accepting her statement. If the sufferer has read upon the subject of cancer, and believes herself to be affected therewith, she will certainly state that the pain is "lancinating, darting, stabbing," and so on, and again the intensity of the pain is sometimes exaggerated. But there is pain which happens to be so characteristic of the class of diseases it accompanies, that its nature and the method of inducing it becomes pathognomonic of the special affection. The anatomist will remember that the integuments over the mamma, as well as the organ itself, receive their nervous filaments from the 2d, 3d, 4th, and 5th nerves of the dorsal plexus; that those branches called intercostal, divide into middle and anterior cutaneous filaments, which are the nerves of this gland, and that they reach the skin by passing through openings between the ribs. The wide-spread distribution of other filaments of these same dorsal nerves should also attract attention (see p. 678). Now when a patient complains of inordinate pain in the breast, with or without induration of the tissues, the acute sensitiveness of the nerves distributed to it is easily demonstrated by digital pressure over the middle or anterior intercostal foramina, whence they emerge upon the chest. In severe cases of this neuralgic affection gentle pressure is intolerable, and the pain extends far and wide over the back, neck, and arm. Even the nerve supplying the particular lobe which is indurated is sometimes alone affected, whilst in actual new growths this is not commonly the case. Thus local pain and pain widely distributed, as well as pain excited by the application of digital pressure with anatomical precision, becomes an important aid in the diagnosis of some of those affections of the breast which excite the greatest alarm in the mind of the patient, although happily they prove to be harmless, in spite of the difficulty sometimes experienced in affording speedy relief.

In every case immediately under observation the surgeon should first attempt to ascertain definitely whether the disease affects the normal tissues of the organ, or whether there be something superadded to them; in fact, a new formation or growth. A tumor, swelling, or enlargement may be felt, and still there may not be any growth in addition to the normal structure; *e. g.*, a single lobe of an inactive gland may be enlarged and cause a suspicion that a new growth exists; but if it be cut out and examined, only gland-tissue is found gorged with epithelium. By careful and methodical manipulation, however, this morbid lobe of gland-tissue, a very common affection too, may be certainly distinguished from a new growth. In this manner examine the part. Press the induration gently between the thumb and fingers, and a tumor is so distinctly felt that the positive existence of something superadded to the breast is affirmed; but now place the fingers lightly and flatly upon the part over the site of the supposed new growth, pressing gently against the thorax, and nothing more than the ordinary gland-tissue is perceptible. On the contrary, if there be a genuine new growth, something developed recently within the normal gland, it will be always felt, in whatever manner or in whatever position the patient is examined.

[This assertion, which is repeated by Gross, is surely a mistake. Minute indurations, such as the beginnings of scirrhus, cannot be detected in this manner with anything like the ease and certainty with which they can be felt when grasped between the thumb and fingers. In the examination of large breasts especially, bi-digital manipulation is as indispensable to the surgeon as bi-manual examination of the pelvic viscera to the gynæcologist. As an example of the value of this method in the diagnosis of very small growths, I will relate the following history. In December, 1876, I removed a cancerous breast from a Mrs. J. Her sister, Mrs. D., became morbidly anxious lest the same disease should develop in herself, and subjected her breasts to almost daily examinations. In September, 1878, she came to me for examination, saying that for a month past she had fancied that there was a lump in her left breast. I could discover nothing until I had subjected the organ to careful manipulation between the thumb and finger, when I was enabled to detect in the deeper part of the breast an induration not larger than a pea. A few days afterwards I cut out the whole gland, and found a very small scirrhous growth. The diagnosis was confirmed, not only by microscopic examination, but also by the recurrence of the disease some nine months afterwards. I do not think that it would have been possible to detect this minute growth in any other way than by what I have ventured to term bi-digital examination.]

Condition of the nipple, and of discharges therefrom.—The ordinary condition of the nipple preceding the observation of the disease should be always ascertained with precision. A congenital defect in its development commonly causes great trouble during suckling; is the promoter of some disease associated with that function; and often accompanies some new growths. It may, however, become retracted when chronic inflammation, or even acute, and lactic congestion affect the organ; and therefore this state cannot be considered of real value in aiding the diagnostication of any special disease. Even when accompanying carcinoma, it merely marks a stage or particular condition of one kind of that disease. The fluids which sometimes ooze from the nipple at the commencement or during the progress of a new growth, may be rendered subservient to the formation of a correct diagnostication of the nature of the disease in the part. Sanious, offensive, opaque discharges, containing cells, identical with those forming growths of cancer, may be regarded as indicative that the induration which would probably accompany the exudation of such fluid arises from infiltrating carcinoma; whilst a bright yellow clear tenacious serous fluid, drawing out into thread-like processes, and the flow of which is perhaps increased by compression on a circumscribed collection of fluid, would guide the surgeon to an accurate opinion that the tumor depended upon the presence of an adenoid growth, or a simple cyst. In a similar manner some of the duct-cysts may be diagnosticated from the mucoid character of the fluid escaping from the nipple. Serous fluid containing colostrum-particles may accompany an excited state of the gland-tissue, sympathetic with diseased ovaria.

[A most important recent observation which we owe to the English surgeons, is that which connects malignant disease of the breast with pre-existing eczema of the nipple. The importance of this observation, as regards the etiology of cancer, cannot as yet be determined. The practical conclusion, as regards the treatment of eczema of the nipple, the reader will be able to draw for himself.]

The lymphatic glands in the axilla and in the neck just above the clavicle should be always carefully examined. Some care is here requisite to ascertain if their morbid condition, when any may happen to exist, preceded or followed the disease in the breast.

In order to ensure perfect accuracy in diagnosis, especially of obscure cases, the breast should be examined whilst the patient is seated, and also when placed in a recumbent posture. The affected gland may then be carefully supported upon the trunk by slightly rolling the body over on to the opposite side and placing a pillow under the shoulder.

Briefly, then, the surgeon will be led to these inquiries: Has the disease under examination any manifest connection with the age of the patient; the stage of development of the gland; its functional activity of repose; and the social condition of the patient? Does it seem to be associated with any general disturbance of the functions of the generative organs? Is it merely a local affection, or more intimately accompanied with general constitutional dyscrasia? Is it of inflammatory origin? Is it traceable to a morbid state of the excretory ducts, or of the secretory structure of the organ? Is the tumor composed of a fluid, a solid, or of both? And, lastly, is the swelling, tumor, or tumefaction really caused by something growing in the breast—a new growth; infiltrating the tissues of the breast; inflammatory or otherwise; or simply a morbid condition of a part or whole of the actual tissue of the organ—an excited state of the gland-structure? In other words, is the disease *in* the breast, or is it a morbid state *of* the tissue composing the breast?

The formation of a correct diagnosis between one disease of the breast and another is infinitely facilitated by employing the method of exclusion or negation; *e. g.*, suppose the patient under observation to be afflicted with a certain definite disease, and then endeavor to ascertain if the facts of the case agree with those indicative of that class. If they do not, that assumption is set aside, and another adopted and examined in a similar manner. This method, however, requires considerable experience, and is not therefore, perhaps, available for very young practitioners. Surely, there is much force in the maxim of Dupuytren, when applied to tumors in this region: "Nothing is more difficult or uncertain than the diagnosis of tumors in general."

General therapia.—First, in relation to the healthful development of the gland from birth to puberty; during pregnancy; and after parturition.

Soon after birth, when the integuments around the mammilla are swollen and tender, great care and attention are required on the part of the nurse, that the dress of the infant does not compress the chest, and thus irritate and injure the rudimentary organ. Should the skin around the areola become red and painful, a thin layer of cotton wool moistened in water and laid on the part, is the most suitable protection. The treatment of the diseased states is described in another place. All manipulation of the swelling is reprehensible in the highest degree.

At puberty the gland should have free scope to allow for enlargement, and pressure on the nipple ought to be carefully avoided. The ordinary tenderness experienced by delicate and excitable girls at this time, and especial at the catamenial periods, requires only repose and the withdrawal of all causes of local irritation.

During pregnancy arrangements should be made in the dress to prevent the clothes compressing the gland, or irritating and squeezing the nipple. If that essential portion of the organ be imperfectly developed, or even inverted, as sometimes happens, and a depression instead of a projection exists, measures may be taken with a view to encourage its development. These would consist in fixing over the areola a circular piece of some thick, unirritating material with a hole in its centre. We believe that very slight advantage is gained by the application of medicated lotions to the nipple, as prophylactics against the irritation caused by suckling. As soon, however, as the colostrum is secreted and oozes from the ducts, the extremity of the nipple should be carefully cleansed with warm water, lest in drying, the mouths of the ducts should become irritated, perhaps obstructed.

After parturition the infant may be allowed to suck as soon as possible, that is, as regards the breast. Its functional activity is not, however, perfect until after the lapse of a few hours from that event. But great distension should never be permitted to occur; and when the secretion forms in such large quantity that the efforts of the infant are unequal to the prevention of this condition, some artificial means should be adopted to avert the ill results consequent upon the neglect of that state. During the earlier periods of suckling the nipple should be gently bathed with warm water when the infant desists; some protection against the friction of the dress is desirable, especially with a tendency to irritable nipples; and all nostrums, applied under the impression of "hardening the nipple," scrupulously rejected. Much vigilance is advantageously employed in seeking for "milk-knots" ["weeds"] or "coring of the milk," as these hard lumps are commonly called. This morbid condition, being due to lobular congestion, will, unless relieved, inevitably proceed to inflammation and abscess. Gentle frictions, with olive-oil, sometimes help to disperse such swellings; but they should not be employed unless by the direction of the surgeon. To the application of warmth and moisture we give the preference; and a careful examination of the orifices of the ducts should be instituted, in search of obstructions from accumulated secretion or epithelium. As the comfort, happiness, and well-being of the mother and infant are so inseparably blended with the healthy performance of the function of lactation, it is impossible to devote too much attention to the search after the least trace of morbid action.

At the time of weaning the breast should never be allowed to become excessively congested with milk. A very small quantity should be removed by artificial means, only just sufficient to relieve distension, never to excite a renewal of secretion. Repose must be enjoined, and an active use of the upper extremities restrained for a day or two. If any circumstance has necessitated the relinquishment of suckling for a brief period, a healthy secretion may be sometimes regained, even after the lapse of a few weeks, by letting the infant suck if it will, or by making use of a breast-pump.

Secondly, in relation to the therapeutics of diseases.

The following remarks refer chiefly to methods of treatment applicable to many different kinds of diseases. The special treatment of any one particular disease is described in that part of the essay devoted to its consideration.

Support and compression.—The principle embodied in every method which has for its object the support or suspension of the gland against the chest, is, in fact, that of repose. By the methodical adjustment of a bandage to the breast, its movements are restrained, and the tissues which are progressively advancing towards a resumption of a healthy state are not liable to those injurious effects which the weight of the gland might exert on delicate, newly-formed structures. A suspensory bandage may be employed. It should be made of some soft fabric with rather open texture, in order to avoid excessive heat. It may be so shaped as to fit the organ, and retained in its position by two broad bands of calico, one passed over the opposite shoulder, the other encircling the trunk below the breasts. An ordinary bandage or roller made of calico, soft linen, muslin, or the elastic woven fabric, about one inch and a half to two inches wide, may be adjusted in the following manner. The surgeon, standing before or behind the patient, who should be sitting, passes an end over the opposite shoulder as low down the back as the lumbar region. The bandage is then carried round the trunk, and the next turn taken over the shoulder, beneath or across the breast, and again around the trunk and then over the shoulder, and so on alternately, until the part is entirely enveloped. In this way, one fold overlying that below it, a very firm, uniform, and tolerable support is afforded. At certain points where the folds of the roller cross, a few stitches may be inserted with advantage. In some cases, strips of lint smeared with an ointment may be laid on the breast, and kept in that position by means of plaster. There are two ways of applying plaster; in a single circular piece, or in strips. If in one piece, a hole should be cut near its centre for the nipple to go through. Incisions should be made from the margins of the circle converging towards the centre, and terminating near the hole. When applied, the pieces slightly overlap each other, and lie flatly. Another plan consists in cutting a piece of adhesive plaster in the shape of a crescent, and fixing it to the abdominal half of the gland. A piece about two inches wide is afterwards placed on the sternal and axillary borders, somewhat obliquely, and extending towards the centre of the clavicle. A third consists in applying strips of plaster one inch and a half in breadth, one piece slightly overlying the one below it. The operator begins at the abdominal border of the gland, and covers as much of it as is needful. During all these operations with strapping, the patient should be in the recumbent posture, and the trunk slightly inclined to the opposite side, in order that the breast may rest upon the chest and not be pendent. Various substances have been used to fix the bandage securely: viz., adhesive plaster outside of it—this may be useful if the skin be irritable; starch, gum, collodion, dextrine and even plaster-of-Paris; but all of these make the bandage very rigid, therefore often intolerable, and when a necessity exists for its repeated application, inadmissible. Should the nipple become ulcerated and require protection, shields are made of various materials; of metal, as lead; of vulcanite; or of something softer, as vulcanized India-rubber.

Sinuses may be injected through the fistulous openings in the skin with various stimulating injections. To do this effectually, it is well to make use of a piece of flexible catheter, which should be introduced as deeply as possible to ensure the full effect of the injection. As a drain-tube, a contrivance, well suited to effect the purpose intended, consists of a piece of very thin gutta-percha, rolled up in the form of a tube, inserted to the requisite depth.

The milk may be artificially removed from the breast by means of exhausting syringes, made for that purpose; by glass tubes or bottles to which some arrangement is affixed in order that exhaustion may be effected by the mouth; or a wide-mouthed bottle may be used, which, after being filled with hot water and emptied, is applied over the nipple. As the air within cools, the mouth of the bottle must be very carefully kept in contact with the breast.

Amputation of the breast.—The proceedings adopted in the removal of tumors from the breast are described in their proper places. The entire gland may be excised in this manner:—An elliptical incision is made upon either side of the nipple, the distance from which may be left to the discretion of the operator. Flaps of integument should be made of sufficient dimensions to fall together readily, without stretching them. The direction of these incisions should correspond with that of the fibres of the pectoralis major muscle. The lower or axillary flap should be made first, and the surgeon will find the accomplishment of the operation facilitated by detaching the gland from the fascia of the pectoral muscle immediately after he has made that flap. Next, the sternal flap is to be cut from the anterior surface of the breast, and then an incision carried around the external border of the gland detaches it completely from the trunk. Loss of blood is, in some measure, prevented by an assistant compressing the anterior intercostal arteries with his fingers placed over each intercostal foramen. Another should put his finger upon the mouth of any bleeding vessel, especially the branch from the axillary artery, which is often of considerable size. Bleeding arteries require to be twisted. The writer has not used ligatures for some time, and has never had a case of recurrent or secondary bleeding after torsion. The integuments should be brought together, and maintained *in situ* by plaster or some other means, according to the inclination of the surgeon. Compresses of lint should be adjusted along the edges of the wound to maintain the flaps and subjacent tissues in close apposition; but openings must be left at either extremity of the wound for the escape of discharges. If secondary hemorrhage occurs, and the wound becomes filled with coagulum, it is advisable to remove all the dressings, clear away the coagula, arrest the bleeding, and rearrange the wound. Cicatrization is greatly impeded by neglecting this procedure.

After careful adjustment of the flaps and the employment of pressure to expel all air from between the detached surfaces, primary union often takes place.

[In amputating for malignant disease, the surgeon should, if possible, cut away not only the visible tumor, but also the zone of apparently healthy tissue around it in which lie hidden the young brood of infectious cells—this necessitates a more radical procedure than that described. The skin should be removed far beyond the limits of apparent adhesion, even though the wound is left without covering. In all cases the fascia should be entirely dissected off, and when the tumor has become adherent to muscle or bone, the muscle should be cut away and the bone scraped and denuded of its periosteum. The axilla should in every case be explored by the finger, which should be thrust through the fascia, even when no perceptible glandular swelling exists. In this way the slightest enlargement of the glands can be detected and the infected organs early removed. Healing by first intention under these conditions is, of course, often out of the question, and such wounds heal slowly by granulation, aided, it may be, by skin-grafting. In all operations for cancer, the surgeon must bear in mind that he operates, not to leave a handsome wound, but to save the life of his patient.]

Special Diseases. Division I.

Morbid Conditions of the Tissues Composing the Breast.

Hypertrophy.—A breast having attained extraordinary dimensions, owing to the gradual growth of the tissues composing the glandular structure, is said to be hypertrophied. This disease is extremely rare. It is quite distinct from that functional enlargement of the organ which is associated with amenorrhœa. There are two conditions which produce a very different appearance of the whole of the affected part. In one, the breast is large, firm, resists the pressure of the finger, and projects in bold relief upon the thorax, the integuments being tense and smooth; in the other the gland is pendulous, dangling loosely from the chest in whatever direction the trunk is inclined; it lies flat and flaccid on the hand, is weighty, tremulous, and constantly varying in shape; when pressed between the fingers, it feels as if its life was gone, were it not for its temperature and tint, since the fibre-tissue seems to possess no vital contractile force. Its shape is sometimes pyriform, the integuments are shriveled and wrinkled, and the apex of the nipple is turned upwards towards the clavicle, instead of in its normal direction. The component masses of the gland are so loosely connected together that the fingers lie in fossæ between them, the whole contour of the organ being totally devoid of its normal and agreeable form. The nipple is generally small, sometimes quite undeveloped, and the areola is spread over a larger area than usual.

This disease commences soon after puberty, or in early adult life, in single women as well as in married. It would appear as if, the growth of the organ having been excited, this action is not controlled, and hence enormous bulk is attained. Both the breasts are affected: generally simultaneously, although, perhaps, they may not be of quite equal size. The general health and nutrition of the sufferer is sometimes good, and is not at all impaired until distress is occasioned by the incumbrance and weight of the masses. Usually the catamenial function is more or less deranged. The author has seen the pendulous hypertrophy accompanied by a new growth, an adenocele, which he removed, but the morbid state of the organ continued. We may distinguish between this disease of the breast and others by regarding the age at which it is developed—for it is an affection of early life; the functional state of the organ; the commencement of the disease tracing back to the development of the gland at puberty; the participation of both breasts in the morbid action at the same time—for it very rarely happens that a new growth so forms in both; the tactile indications, remembering that occasionally a new growth may be superadded; the generally, at first, unimpaired health of the patient, and the absence of local suffering. Neither constitutional nor local remedies produce any marked benefit. Should the catamenial function be morbidly affected, all due attention must be paid to the fact, and remedies likely to improve its condition may be prescribed. Amputation of the larger of the breasts has been successfully performed; but it is a measure to be had recourse to only under most adverse circumstances. Nevertheless, in some of the cases, after the operation the remaining breast diminished considerably. In a case reported by M. Bouyer, both breasts were successfully removed, the patient losing by the operation one-third of the weight of her whole body before its performance. After a critical examination of several of the recorded cases of a single breast, we may be allowed to question the correctness of applying the term hypertrophy to them, and to doubt their being really examples of this disease. Doubtless in many the dimensions of the breast were caused by the development of a new growth, as in the case published by Dr. Ashwell in 1841.[1]

Atrophy, or wasting of the secreting tissue of the breast, commonly takes place as life advances, and the procreative functions cease. The gland is very generally replaced by fat, so that the outline and form of the organ is preserved. The ducts are always persistent, and sometimes contain a tenacious mucus.

Occasionally in early life, the secreting tissue is so far atrophied that, even during pregnancy, the ordinary changes in the organ do not take place, and after the birth of the child there is a total absence of the secretion of milk. The breast often wastes when new growths are developed therein, and even in young persons adenoceles are sometimes seen to take the place of the normal organ. Very protracted lactation and rapid repetition of the function, in delicate women, exert a baneful influence on the fibrous structures, which interferes with the healthy form of the gland in after-life. And, in some persons, after weaning, the glandular tissue shrinks so remarkably that scarcely any breast remains; nevertheless, during a subsequent pregnancy, the normal changes take place, and the organ performs its functions in perfection. In fact, as a rule, a mother with breasts of this description generally proves a more efficient nurse than another in whom the large dimensions of the gland might be regarded as indications of its perfection.

Inflammation and its results.—The various kinds of this morbid action occur at every age and in all conditions of the organ. They rarely arise either before puberty, about that period, or during the inactive state of the gland. But, on the contrary, they are very common in the adult and during lactation. During pregnancy and when weaning, inflammation very rarely happens; but it is more common during the former period than the latter. And, when developed at weaning, it is usually excited by an accidental circumstance, *e. g.*, the death of the infant, or illness of the mother, necessitating the abrupt discontinuance of suckling. In the majority of instances it is secondary to local irritation, especially ulceration of the nipple, obstruction of a milk-duct, or a contusion; and, as an occasional source, we must notice a diseased state of the axillary lymphatic glands. Having stated that it arises, first, in the inactive stage of the organ, and secondly, at periods of its functional activity, we may next describe its effects in relation to those different conditions.

During infancy.—Soon after birth, in both sexes, although most commonly in the male, the mammilla frequently becomes swollen and painful, the skin around slightly pink, and there may be a serous fluid, or even milk, secreted, which oozes from the ducts. Nurses who indulge the propensity to interfere with the processes of nature, by "rubbing away the milk," too often excite inflammation, which is indicated by the usual local and constitutional signs, and sometimes passes on to suppuration. Even eight days after birth this rudimentary organ occasionally causes much pain from slight inflammation becoming developed around it, which cannot be assigned to manual interference. And in a female infant, three months old, we have seen an abscess in this region, the exciting cause of which it was not possible to discover, except it was constitutional delicacy. The mother of this infant stated that, unlike others, there was not in this one any secretion in the breasts after birth, and that, consequently, the usual means "to rub away the milk" were not employed. We need scarcely say that, as a prophylactic measure, every cause of irritation must be carefully removed from the excited organ; even the friction of the dress against it should be prevented in delicate infants. With a tendency to inflammation, warmth and moisture may be maintained over the affected part by using the softest applications, such as moist cotton-wool, or some medicated lotion may be advantageously employed, *e. g.*, liq. plumb. diacet. dilutus.

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[1] Guy's Hospital Reports, vol. vi., p. 203, with a plate. This proved to be a large new growth, an adenocele; and it was subsequently removed by Mr. Stanley, in 1843. The tumor is preserved in the Museum of the College of Surgeons (preparation 208).

We have selected for reference the following cases recorded within the present century, and have arranged them in two groups: 1. Those in which the disease commenced at puberty. Hey, Practical Obs. in Surgery, 8vo., 3d edit., 1814, p. 500; Cooper, Illustrations of Diseases of the Breast, 4to., 1829, p. 70; Huston, American Journal of Med. Sciences, 1834, vol. xiv., p. 374; Malgaigne, Gaz. des Hôpitaux, 1844, p. 599. 2. Cases in which the disease commenced after the establishment of puberty, in married women and unmarried. Delfiz, in Majendie's Journal de Phys. exp. et path., 1825, t. v., p. 396; Schaal, in Rust's Mag. f. d. gesammte Heilkunde, 1825, b. xix., p. 360; Cerutti, L., Meckel's Archiv f. Anat. u. Phys., 1830, p. 287; Hecker, Med. Zeitung v. Verein f. Heilkunde in Preussen, 1837; Skuhersky, Weitenweber's Neue Beiträge z. Med. u. Chir., 1841, p. 42; Bouyer, Gaz. méd. de Paris, 1851, p. 301.

At puberty.—Associated with the development of the breast in the female, inflammation very rarely occurs, although the gland often becomes exceedingly painful, and the nipple and areola of a deeper red. But after puberty, when the organ is developed but inactive, both acute and chronic inflammation arise; for which it is often difficult to assign a cause. Chronic abscess is certainly more common than acute. This disease occurs in delicate strumous girls; it usually commences as a hard, painless, defined swelling, with sometimes slight uneasiness. In this stage it may be easily mistaken for a new growth, until, as the tumefaction enlarges, it becomes softer and softer, and fluctuation is detected. Then it is supposed to be a cyst, as very little pain has been felt, and constitutional disturbance has not been excited. At last the swelling is punctured and the pus escapes. In this way the discovery of the contents of the cyst is frequently made, and all doubt as to the nature of the complaint is removed. Cases of this kind deceive even the most experienced surgeons. Operators, acknowledged to be the greatest adepts at diagnosis, have proceeded so far even as to commence an operation for the removal of a new growth from the breast, which proved to be but a chronic abscess; and therefore the careful surgeon should always suspect the existence of a chronic abscess until there be most unequivocal indications that the disease is of another kind. [The use of an exploring needle would render this kind of mistake entirely unnecessary. It is strange how commonly systematic authors ignore the value of this familiar and very useful little instrument.] In cases of this class the disease appears to depend chiefly upon some constitutional defect, and therefore the rule as regards treatment is to improve the general health. It would be idle to enter at great length into the treatment of this malady. Bearing in mind the anatomical disposition of the organ, and its relation to the surrounding structures, it demands no very special mode of treatment. We may therefore pass on to that kind of inflammation and abscess so commonly developed in the breast at the time it is an active secreting organ, or preparing to become one.

During pregnancy and lactation.—Inflammation rarely occurs whilst the breast passes through those phases which render it a secreting organ. At this time it is often very painful, and there may be slight vascular excitement; but inflammation is not developed unless some injury chance to be inflicted by sudden violence or continued compression exerted by the clothes.

It is, however, very common during lactation. Generally it happens with primiparæ; and, in a majority of cases, it is determined by either a defective development of the nipple or a morbid state of it. It most frequently arises during the first month after childbirth.

The examination of 149 cases of inflammation ending in abscess showed that in only 17 women the disease was not associated with lactation; whilst in the majority, 132, it arose in those who were suckling. In 118 cases, either inflammation or abscess occurred in more than half of those who had given birth to a first or second child, and nearly one-third were primiparæ. An inspection of the nipple showed that in 97 cases of abscess this important part of the gland was imperfectly developed in 48, and diseased in 19, whilst it was well formed and healthy in 30. Thus we find half the cases associated with defective nipple; and adding to these the patients with unhealthy nipples, we have more than two-thirds of the cases of inflammation and its results complicated with, and probably excited by, malformations or diseases of the aggregation of the excretory ducts constituting that organ. As to the period after parturition when inflammation occurs, I found, in 116 cases, that it commenced during the first month after parturition in half of them, viz., 58 cases, and in a large proportion of these during the first week. In the other 58 cases, commencing after the first month, in 11 it began during the second month, in 8 during the third, in 22 between the third and eleventh, and in 17 between that month and the twenty-first. Now, as very few mothers continue to suckle for so long a time, it would seem that abscess depends very commonly upon protracted lactation, and probably the constitutional exhaustion excited thereby.

The above facts teach us the following lessons, which, if fully accepted in that light, may prove of great importance, and save much misery. They should induce the surgeon to anticipate the probable result concurrent with the conditions described, and they furnish a substantial basis upon which to propose prophylactic measures in order to avert the ill consequences arising from them. Thus it behooves the medical attendant upon a primipara to examine carefully the condition of the nipples; and if there be any imperfection, to employ means to excite their development, or, at least, to prevent the gland-tissue from becoming so gorged with milk as to conduce to subsequent mischief. Occasionally diminishing the distension by removing small quantities of milk with a breast-pump will prevent lactic congestion, the forerunner of inflammation and its results. Also, it often happens, when the gland-tissue is much congested, that the orifices of the ducts in the nipple are more than usually inverted, and that relatively with a more empty state of the whole organ the nipple becomes more prominent. The opening of one or more of the ducts is sometimes obstructed by an accumulation of epithelium, which is indicated, according to Dr. Ratzenbeck, of Prague, by a very minute white projecting translucent vesicle. The milk-congestion of that lobe, the duct of which is thus blocked up, may be relieved by the withdrawal of the cause producing it.

Semeiology and progress of inflammation.—The earliest deviation from a healthy state of the gland is usually indicated by more or less induration, which involves one or more of its lobes. Slight uneasiness in the act of lactation, or during the movements of the arm, often leads to its discovery, for in this stage (the first) the pain is not acute. Occasionally, patients state that a sensation of chilliness, or a shivering fit, preceded the discovery of the "lump, knot, or coring of the milk," as it is commonly called. In this stage, the secreting portion of the affected lobe is simply congested with milk, and especially the more solid portions of that secretion. The skin over the induration is not affected, and gentle manipulation of the part is tolerated without inconvenience. With very variable rapidity, in different cases, the induration increases; more and more of the lobes are affected, until at last the whole organ becomes involved in the disease. This constitutes lactic congestion. It sometimes takes place with but slight inconvenience, caused at least by pain, and without exciting much constitutional disturbance. In other cases, the disease advances rapidly; the skin becomes red, swollen, and even œdematous, usually over the primary induration; great suffering is caused, and severe constitutional excitement aroused. As time passes on, the length of which cannot be fixed with any uniformity, suppuration takes place, and the pus collects either in the breast, behind it, or upon its cutaneous surface.

Hence the division of mammary abscesses into three classes: superficial or super-mammary, intra-glandular, and sub-mammary. Each kind is characterized by a peculiar train of symptoms, and very marked local indications, which we must now describe.

The superficial abscess, bounded by the cutaneous surface of the gland behind and the integuments in front, generally pursues a rapid course, and is not attended with very severe constitutional disturbance. In very cachectic women, however, the action is not limited; but it extends along the connective tissue around the whole gland, destroying it, and causing diffused suppuration, and, in rare cases, a wide-spread destruction of the skin. But in those superficial collections of pus, that fluid quickly makes its way towards the integuments, by the natural process termed "pointing," and the contents of the abscess escape. The usual local and constitutional symptoms accompany the morbid action, which it would be idle to describe here. (See INFLAMMATION, Vol. I.)

Intra-glandular abscess, the result of inflammation affecting one or several of the component masses of gland-tissue, is attended by local and constitutional symptoms of much greater severity than the variety last described. The pus collects within the fascia of the organ. The local pain is often agonizing; the rigid texture of the gland-tissue, yielding slowly, compresses the inflamed structures, and the intense throbbing, burning heat, and heavy weight complained of produce sufferings with difficulty mitigated. The integuments slowly participate in the morbid action, and the whole breast sometimes becomes double the normal size before either redness or swelling takes place on the surface. At last, however, at a spot usually over the site of the primary hardness and most painful point, the integuments yield slightly to pressure, where there may be also slight redness and œdema. From this the superficial inflammation extends, and, in a few hours afterwards, fluctuation of pus is felt. The constitutional symptoms are usually severe. After the first forty-eight hours from the discovery of the first hard spot, acute pyrexia is frequently developed, and accompanied sometimes with cerebral disturbance and excitement.

Sub-mammary abscess is characterized by the remarkable appearance of the whole organ. The breast seems to rest upon, or to be pushed forward by, something developed behind it; and, when slight pressure is used with the whole hand in a direction towards the thorax, the part feels as if it were resting upon an air-cushion or something elastic. This disease is generally slow in its progress; the local pain attending its development is commonly not so severe as in that last described, the redness of the integuments covering the breast is very slow to appear, and the nipple is often remarkably free from all disturbance. Constitutional reaction is not often excited until a somewhat late period; scarcely at all in some patients, until the fascia or the integuments, or perhaps the gland itself, become involved. The progress of the pus through the integuments is slow, and very often pointing takes place at several spots around the periphery of the gland; or the pus makes its way between the lobular masses of the organ, and an opening forms near the areola towards its sternoclavicular border, that part of the gland being the thinnest.

[Sub-mammary abscesses may also occur as the result of caries of a rib or of the breaking down of tubercular deposits in the pleura. Such abscesses are usually small, well defined, painless, and hard. They are frequently mistaken for solid tumors of the deeper parts of the breast, but can be easily diagnosticated by the fixed relations which they maintain with the ribs when the breasts are moved over them. The exploring needle will show their true nature. Their prognosis is usually bad, as they happen rarely except in patients of scrofulous habit.]

The treatment of inflammation must be conducted upon general principles; for those which are applicable in like conditions of other tissues of the body should be the guides for the administration of remedies when that disease affects the breast. However, a marked peculiarity of the organ affected arises from the fact that it is an active secreting gland in a majority of the cases; and the disease is often developed soon after child-birth, and therefore intimately associated with the puerperal state. In these circumstances, then, we have additional elements which require attention.

When merely a part of the gland is indurated and painful, without redness of the skin, a careful examination of the nipple should be made with the view to detect any obstruction of a duct or irritation about the orifice of one. Should the gland become much congested, mechanical means must be employed to remove the milk. Suckling need not be abandoned; but care must be taken that the gland-tissue is really fairly emptied of its secretion. The application of an evaporating lotion, or of one containing liquor plumbi, made warm before using it, frequently gives relief. The arm of the affected side ought not to be actively used; and a bandage should be adjusted in such a manner as to prevent the weight of the breast dragging upon the affected part. If the patient lie in bed, the breast may be supported on her chest, or a pillow may be arranged between the arm and affected side, upon which it may rest—a method which, in some cases, is more agreeable than a bandage. Careful attention must given to the condition of the alimentary canal, and a gentle aperient is often beneficial.

As soon as the skin becomes red, the local application of warmth and moisture is indicated. This principle may be carried out in many ways, the details of which it would be idle to relate here. The abstraction of blood, by means of leeches, may be useful at this stage; they should be made to bite at the periphery of the breast, nearest to the site of the inflammation, in preference to the part where the redness exists. The quantity of blood drawn must be regulated by the state of the general health of the patient, which commonly requires supporting rather than depressing. Nevertheless, in strong healthy young mothers, where the difficulty arises from deformity of the nipple, active local and constitutional measures are quite justifiable, and are frequently attended with great benefit. At the bedside, the practitioner has in fact, first, to establish clearly the cause of the inflammation; secondly, to consider carefully the constitutional condition of the patient; and the treatment of the case must be regulated by the indications afforded. One word of caution in reference to lowering the reparative powers of the patient. We believe that the practice is often carried too far, and that much greater advantage is gained by giving support at the time inflammation exists, not alone with the view to its resolution, but prospectively upon the chance of suppuration taking place. Cases of acute inflammation of the breast during lactation, have been successfully treated by covering the whole organ with collodion.

Abscess; how it is to be opened, when, and where.—The question is often asked, Is it advisable to open the abscess artificially, or to leave the pus to escape by natural efforts alone? Should the pus be superficial, the local action circumscribed, pointing advancing without threatening destruction of much skin, and the constitutional disturbance trivial, the contents of the abscess may be allowed to escape by the processes of nature. But if the skin turns purple beyond perhaps an inch, and the cuticle peels off for a wider extent, the introduction of a lancet at the centre of the purple spot becomes necessary to prevent further extension of the mischief and gangrene of a large area of the cutis. The opening into an abscess of this kind should be free; a mere puncture will not suffice. It should be sufficiently large to allow the pus to escape readily; pressure to hasten its exit must be studiously avoided, that the walls of the abscess may collapse naturally; and the breast should be carefully supported with a bandage.

Abscess confined within the fascial envelope of the breast and between its component masses should not be interfered with too soon, unless the constitutional disturbance excited by the retained pus in its efforts to make its way to the surface be uncommonly severe. When, however, the skin becomes red and œdematous, a spot, softer and more yielding than the surrounding parts, may be generally detected. Very commonly this is discovered over the site of the primary hardness. Now, if the local pain be severe, the constitutional disturbance excessive, and the patient much exhausted by the tedious progress of the complaint, the introduction of a bistoury at the soft spot before mentioned, affords almost instantaneous relief by diminishing the tension of the inflamed tissues, which was induced by the pressure of the fluid.

In cases of sub-mammary abscess the pus makes its way to the surface very slowly; the constitutional symptoms are not generally so severe as in the last-described variety; and it is in most cases desirable to seek the spot, from time to time, at which nature is effecting an opening for the escape of the pus. This most commonly happens somewhere around the periphery of the gland; rarely the pus burrows through it, in which case pointing takes place over that part of the breast where the gland-tissue is thinnest, *e. g.*, in the quarter between the nipple and the sterno-clavicular articulation. In order that the pus may escape most freely, an opening at the lower border of the gland is considered preferable to one in any other part; but it may be as well to state that in this kind of abscess the disease is seldom cured after making one opening only. These are the cases in which numerous apertures are often formed; fistulæ and sinuses, traversing in several directions, burrow behind the gland and between its compact masses, producing an amount of suffering, and depression of the system generally, very difficult to obviate. When the pus points, ordinary rules suffice to guide the surgeon in the treatment of the case.

[Billroth strongly recommends the antiseptic incision of intra-glandular abscess. His method is as follows:—

After first washing the breast with soap and water and then with a solution of carbolic acid, an incision not longer than a centimetre is made in the radius of the mamma. A drainage tube held ready in the hand is thrust quickly into the abscess and fastened there. The breast is squeezed softly until pus flows through the tube. The mamma is then drenched with antiseptic lotion, and the whole breast and axilla covered with Lister's gauze and salicylated jute. The antiseptic bandage which holds the dressing in place should be passed around the whole thorax. The sound breast must be thoroughly covered with cotton, and cotton placed thick in the sound axilla. The bandage should be renewed in a variable period of time—in twenty-four hours if the abscess is large and sinuous, in from three to five days if it is small and superficial. In eight or ten days of this treatment the abscess will completely heal.]

Other methods of emptying abscesses are employed by surgeons. Some prefer to remove the pus by means of a trocar and canula, making at the same time a somewhat valvular puncture; and when all the pus has flowed, the sac is washed out with tepid water. The canula is then removed, and the whole organ strapped up in order to keep the walls of the abscess in contact. This method is reported as successful in effecting that which may be termed the primary cure of abscess. Others, after emptying chronic abscesses, inject solutions of iodine; and a vulcanized India-rubber drainage-tube, introduced into the cavity of the abscess, is said to hasten cicatrization. These methods of treatment are not, however, generally available in acute abscesses, but may be employed in those of slow formation and unconnected with lactation.

Treatment after an abscess is open.—For a few days it may be well, in some cases, to apply warmth and moisture to the surface of the breast generally; but we have not found any advantage to be gained by encouraging suppuration, as the long continuance of poulticing usually does. On the contrary, we prefer to cover the opening lightly with a small piece of wet lint or cotton-wool, over which very thin gutta-percha is laid, to prevent rapid evaporation, immediately after the flow of pus has ceased; and then to support the part carefully with a suitable bandage. The diet of the patient should be nourishing, not too stimulating, although there is no objection, if the patient be low, to allow some mild stimulant to be taken. Under similar conditions, tonics must be likewise administered.

Consecutive abscesses not unfrequently occur. This circumstance usually happens in those instances of general congestion of the whole organ before described. As a sequela of abscesses, sinuses sometimes remain a long time, being very difficult to heal. Stimulating injections, strapping up the breast with plaster, and applying a bandage methodically (p. 682), and as a last resource, cutting them open, are means towards effecting cicatrization.

Milk fistulæ will not usually heal until the secretion of the gland is arrested.

Chronic induration of the gland-tissue may affect the whole of the gland, or only portions of it. The degree of hardness thus produced is sometimes sufficient to excite the alarm of the patient and the anxiety of the surgeon. A minute examination of the gland-structure thus diseased shows that those tissues of the organ in which secretion takes place, that is to say, the cæcal terminations of the ducts, are the parts principally involved in the morbid action. During the inactive condition of the breast, when its tissues are soft and yielding, although somewhat firm to the touch, the cæcal terminations of the ducts are scarcely recognizable in the field of the microscope. Here and there, perhaps, a trace of them may be discovered by small accumulations of epithelium. But when the breast-tissue is indurated, the cæcal terminations of the ducts are gorged with epithelium, the acini become perfectly distinct, and a somewhat excited state of the organ seems to be the cause of the development.

This morbid state is seen in breasts of all shapes and sizes; the large, heavy, pendulous variety is thus affected as well as the small, atrophied, disc-shaped organ. When manipulating the first variety, the gland seems to be distinctly circumscribed, and it feels just like a great ball under the integuments; in the last, the fingers may be insinuated beneath its borders, and the whole mass feels like a quoit covered with skin. When a single mass of gland-tissue is affected, or perhaps two or three neighboring masses together, or in different parts of the same organ, the indurations resemble tumors formed by a new growth, and they are frequently mistaken for adenoceles or cancer. The induration is most distinctly felt when it is pressed between the finger and thumb, or the breast is grasped from side to side and raised from the pectoral muscle. When pressed flatly against the chest, it is imperceptible as a hard mass. In most cases complaint is made of severe pain, and in some nervous excitable women the suffering occasioned is described as agonizing. The slightest touch is scarcely endurable, and any pressure upon the induration produces an immediate outcry of distress, of which the countenance of the patient is also an index. The cheeks are often suffused with a bright-red blush as well as the throat and neck, although occasionally the effect of the sudden pain is to produce the very opposite result, when the cheeks become pallid, the pulse small, and a sensation of faintness, nausea, and even syncope may occur. But the pain is not confined to the affected breast. Patients complain of its wide-spread distribution, and some state that it shoots up the neck, others behind to the back and especially the blade-bone, and often down the arm. The surgeon too will discover that the slightest pressure over the intercostal foramina, whence the mammary gland nerves escape from the chest, either the middle or anterior branches, induces acute pain, and that sometimes even a single branch is alone affected, whilst all the rest are not. And it may be observed that the filaments of the painful branch are distributed to the indurated part of the breast. The pain is commonly paroxysmal, lasting various periods of time, and recurring without any assignable cause. It will sometimes even cease to be felt in the breast first affected and pass to the other; again change; and thus alternate from side to side. There is not a trace of inflammation in the integuments. The breasts of unmarried women between twenty-five and forty years of age are most commonly affected; and of the married, sterile women are much more subject to this affection than prolific. General functional disturbance of the generative organs usually accompanies this state of the breast, sometimes indeed precedes it. The opposite derangements — amenorrhœa, menorrhagia, dysmenorrhœa, and commonly profuse leucorrhœa — are the manifestations. The general health is also much disturbed, the rest broken, and the nervous system highly excited.

[In girls of scrofulous habit, chronic indurations may form, which are painless, and prone to cheesy degeneration. They will sometimes last for years, and then break down into abscess. One such case, a girl of twenty, whose neck was disfigured by great masses of swollen glands, had multiple indurations in the left breast. After many months, they suppurated and discharged a cheesy pus — chronic sinuses resulted, which were finally cured by the insertion of setons. Other chronic indurations are with great difficulty diagnosticated from real tumors. They will appear with little or no apparent cause, persist for months, and then often undergo a process of absorption. The pathology of these cases is exceedingly obscure. Dr. Brownell, of Utica, Michigan, called for my counsel in a case of this kind. Mrs. A., aged twenty-five years, the mother of several children, had unusually large mammary glands. While climbing a fence one day, in June, 1874, she hurt her right breast. It felt sore for some time afterwards, and became abnormally hard. She had not nursed a child for three years, by the way, and was not pregnant. Three months after the injury Dr. Brownell found the breast one-third larger than its mate, and hard and nodulated. It was not sore nor painful, but she suffered shooting pains in the corresponding arm and shoulder. I examined it a few days afterwards and found numerous tumors, which were plainly perceptible when the hand pressed the breast on to the thorax, and which were scattered through the whole organ.

The axillary glands were not affected; the other breast, very much smaller, seemed normal. The treatment pursued was the daily application of compound iodine ointment, and thorough and constant compression. A sponge large enough to cover the whole breast was compressed under heavy weights, applied dry to the breast, and bandaged tightly in place. The application of water and the consequent swelling of the sponge produced thorough compression. After some weeks one nodule suppurated. In no other one was there the slightest appearance of active inflammation or suppuration. In Jan., 1875, adhesive plaster was used instead of sponge as the compressing agent. In March all trace of induration had disappeared, the breast had become smaller than the left one, and was well. I will say, before closing this history, that the largest of these tumors must have been an inch in diameter.]

The diagnostication is aided by the history of the case; *i. e.*, by the age of the patient, her social condition, constitutional health, and functional derangement of the generative organs. Manipulation, methodically employed, also assists materially. If the nervous filaments be sought for and pressed upon, the pain induced is almost pathognomonic of the disease. When the hand is passed gently over the gland, nothing indicating the existence of a new growth is felt, which always happens when one exists; the induration is very distinct if compressed between the fingers and thumb, but imperceptible with the hand flatly placed upon the part.

The constitutional treatment consists in the employment of every measure calculated to improve the bodily health: thus, mild aperients, alteratives, various kinds of tonics, the mineral acids, iron, quinine, and in some cases sedatives, exert a very beneficial influence. As a topical application, the liquor plumbi diacetatis dil., an evaporating lotion, or even one slightly stimulating, may be employed. When the pain has not been severe, we have known instances in which the induration was dispelled after strapping the whole organ with plaster, having first covered it with ceratum hydrargyri comp., or strapping with emplastrum belladonnæ alone. All direct local pressure should be carefully removed; and if the breast be pendulous, it should not be allowed to hang loosely without some support.

Effusions of blood caused by contusions.—Injuries of this kind produce swellings of greater or less magnitude in the breast. If the blood be extravasated within the fascia of the gland, the skin does not always show ecchymosis. But the history of the case will generally aid in the correct diagnostication of the disease.

Of course such a swelling may show itself at any age after the development of the organ, and in whatever state it may be; therefore some difficulty may not improbably arise in distinguishing between a tumor formed by extravasated milk and one by blood, but galactocele is not often associated with violence well known to have been inflicted, whereas the blood-swelling always is. The first is painless usually; the last is accompanied with considerable pain. Inflammation and suppuration take place in these blood tumors rarely; they generally diminish slowly, and at last disperse. A slightly stimulating lotion applied to the part hastens absorption of the blood.

Ecchymoses occasionally appear in the integuments over the breast in association with amenorrhœa; and discharges from the nipple of a blood color escape, under similar circumstances, which must be carefully kept distinct from those which occasionally accompany carcinoma of the gland.

Hyperæsthesia.—Under the term more commonly in use, "irritable mamma," is understood an exalted state of sensation in the skin covering the breast, as well as in the gland itself.

The suffering which patients undergo is sometimes most intense. The very thought of a person touching the part adds to the torture, and even the gentle contact of the dress can be scarcely tolerated. The affected breast is usually larger than when in a healthy state; it is firm, conical, projecting; the skin is generally red, from its bloodvessels being congested; the nipple is prominent and appears swollen. This state of the breast is very variable from day to day, the pain being sometimes confined to one gland only, at other times occurring in both, and occasionally alternating between one and the other. It will also suddenly cease, and return again as unexpectedly and without any assignable cause. Nor is the pain confined to the breast; it extends to the spine, neck, shoulders, arms, and hips. Young girls are more frequently thus affected than females above the age of twenty-five. Generally this affection is associated with an utterly disordered state of every function, a nervous excitable temperament, and especially derangement of the catamenial discharge, dysmenorrhœal, amenorrhœal, or the contrary. This condition is doubtless excited by sympathy with the pelvic generative organs, and may probably be excited by indulgence in depraved habits. Its treatment consists in enforcing strictly hygienic measures—all the excretions must be restored to a normal state, from which they generally widely depart—and the application of some soothing lotion at the moment of the more acute paroxysms of pain.

FUNCTIONAL DISORDERS.

Abnormal secretion of milk.—This anomaly relates to the age of the woman, and to a condition unassociated with pregnancy.

Cases are recorded in which the breasts of old women have secreted milk;[1] others in which the secretion was formed at a very early age[2] (eight years); and of some women, reputed virgins, whose breasts secreted a troublesome amount of milk.[3]

Agalactia, or want of lactic secretion, depends upon an organic imperfection of the gland, as already stated (p. 673), and occasionally upon constitutional causes. This secretion may be excited by the application of the leaves of the castor-oil plant to the breast,[4] as well as by warmth and moisture, and the stimulus of the act of sucking.

Galactorrhœa.—This term expresses an excessive secretion of milk, which is constantly flowing away; as well as the continuance of the secretion after weaning, either at the conclusion of a proper period or as the result of a sudden removal of the suckling.

These conditions usually affect delicate females, and are associated with some derangement of the catamenial function. Measures to improve the general health must be enforced, and such medicines as give tone and power to the system should be administered. An application of the extract of belladonna over the breast, or even strapping it with adhesive plaster, will in some cases be useful. We have seen the preparations of iodine and of iron, given separately or in combination, exert a beneficial effect in these cases. Dr. Laycock recommends hemlock, used as a poultice, and given internally with opium in pills.

Congestion with milk.—The gland sometimes becomes excessively congested with its own secretion. This seems to depend on the more solid constituents of the milk being formed without the serous. For the more fluid portion appears to be an important agent, not only in diluting the nutritious element, but in favoring its ready escape.

It is probable that the sensation experienced soon after the infant is placed to the breast, called "the draught," is produced by more blood being distributed to the gland, and a rapid development of serum taking place. In cases of the kind under consideration the breast assumes enormous proportions. It becomes of stony hardness. The skin is stretched, not much changed in color at first; the nipple seems to be drawn in, but is rather imbedded in the skin, which is raised up around it, and flattened; the local pain is not severe; and although the mind is much disturbed by apprehensions regarding the nature of the disease and its ultimate results, the constitutional effects are not nearly so severe as, *à priori*, might be expected. The progress of the disease is excessively slow. Generally it terminates in inflammation and abscess. We may here observe that the morbid affection is usually confined to one breast, and that the function of the other one is performed in the most healthy manner. Also, that we have seen cases in which the gland, after regaining a healthy condition, was competent to the performance of its function at a subsequent parturition. The disease for which this one is most likely to be mistaken is carcinoma. But that disease is so excessively rarely developed during suckling, that the bare suspicion of it may be at once banished; especially if undoubted evidence can be obtained that there was no tumor in the breast before the birth of the child. The plain fact that the morbid state of the gland is immediately associated with the activity of the organ is, when accepted as negative evidence, almost pathognomonic of the nature of the diseased action. The treatment consists in strapping the whole breast with adhesive plaster, in the application of an ointment of iodide of potassium, iodide of lead, or the tincture of iodine, and in improving the general health.

SPECIAL DISEASES. DIVISION II.

NEW GROWTHS, FORMING TUMORS, THE ELEMENTS OF WHICH MORE OR LESS RESEMBLE THOSE COMPOSING THE GLAND.

Adenoma.—This term is employed to indicate a kind of new growth, the tissues of which closely resemble those of the breast-gland itself. It is synonymous with the following designations: "Chronic mammary tumor," Sir A. Cooper; "Pancreatic sarcoma," Abernethy; "Tumeur adénoïde," Velpeau; "Corps fibreux," Cruveilhier; "Hypertrophie partielle," Lebert; "Mammary glandular tumor," Paget; "Hydatid disease of the breast," Sir A. Cooper; "Carcinoma hydatides," Sir C. Bell; "Sero-cystic sarcoma," Sir B. Brodie; "Cysto-sarcoma," Müller; "Tuberous cystic tumor," Cæsar Hawkins; "Proliferous cysts," Paget. Such a variety of names is sufficient to indicate the extreme diversity of outward form seen in these growths. Following their structural arrangements, we may make such a natural division of them as to include in three principal groups all the varieties met with in practice.

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[1] Abridgment of Phil. Trans., vol. iii., p. 80; Diemerbroek, Anat. corp. Human.; Riberi, Raccolta delle Opere Minori, 2 vols., 8vo., Turin, 1851; Livingstone, Missionary Travels, etc., in South Africa, p. 126.

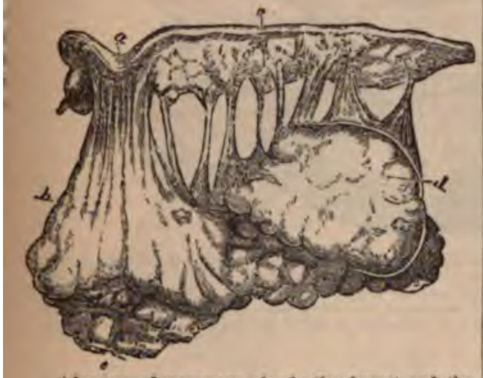
[2] Baudelocque, Art d'Accouchement, tom. i., p. 188.

[3] Riberi, op. cit.; Heister, Obs. cclxxiii., p. 325; John Dix, in Med. Times and Gaz., p. 89, Jan., 1856; Braithwaite, Retrospect, vol. xviii., p. 376; Cases in London Journal of Medicine, vol. i., p. 85.

[4] The Lancet, Sept., 1850; Edinb. Monthly Journ. of Med. Science, Oct., 1850; London Journ. of Med., vol. ii., p. 951.

The accompanying woodcut demonstrates the relation of such growths with the mammary gland.

Fig. 924.



Adenoma of mammary gland; the breast and the new growth dissected to show their relations to one another. Removed from a single woman, æt. 26. Six years' growth. Guy's Hospital Museum, 2292^{5}. *a.* Site of nipple. *b.* Breast gland. *c.* Suspensory bands between skin and growth. *d.* New growth surrounded by its fibrous envelope. *e.* Several small cysts with mucous contents.

In the *first group* the growths are compact, dense, firm, fibrous, lobulated, and invested by their own fibrous capsule. The varieties in this group consist of new growths, in which the observer may detect ducts, sinuses, and even the secretion peculiar to this gland; of others, very succulent, in which ducts are traceable in progress of development; and of those not succulent, very fibrous, crisp, dense, minutely lobulated, and possessing the cæcal terminations of the ducts only. The surface of a section of the tumors in this group shows a very variable arrangement of the elementary structures. In some it is quite smooth, divided into larger or smaller lobes, and compactly united together by connective tissue; in others it is broken up by fissures running in all directions and without any definite order; whilst in others, the surface is as irregular as it is possible to conceive, and appears as if the minute lobules would drop off from the general mass.

In the *second group* are cystoid[1] formations having growths within them which appear to spring from their walls, are floating and pedunculated, or sessile, and have very little connective tissue between them. These intra-capsular growths are often bathed in fluid. Variety appears in this group by the tumors being composed of large lobed, pedunculated masses, not connected together, although each lobe consists of lobules containing acini and the cæcal terminations of the ducts, together with connective tissue. In other specimens the small lobulated masses are attached to membranous septa from which they are pendent; and in others sessile masses are dispersed upon the wall of a large membranous capsule which contains the characteristic serum. This fluid is usually of a pale yellow tint, tenacious, adheres to the fingers, and draws out in threads. Any deviation from this color is due to the admixture of coloring matter from the blood.

In the *third group* we arrange those cystoid formations referable to the dilatation of the ducts or sinuses, and connected with them, which contain growths apparently springing from their walls and composed of tissues resembling those of the gland. Sir B. Brodie first described them, and they are very rare (Lectures on Pathology and Surgery, Lect. vii.). A drawing of a very remarkable specimen of this disease is published by Dr. H. Meckel in the Illustrirte Med. Zeitung, 1852, b. i. It is the finest one delineated.

Adenoceles usually commence as a hard

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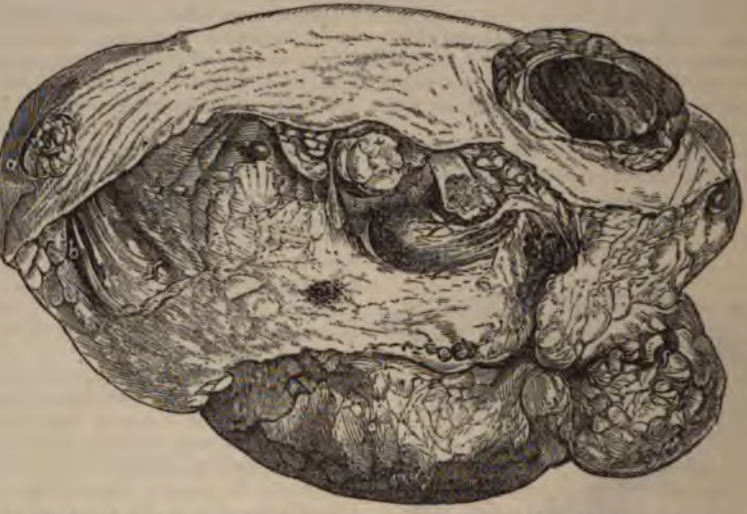
[1] These so-called cysts resemble much rather the arrangement of the capsular ligaments of joints attached around the articular ends of the long bones than genuine cysts. It would be much more easy to comprehend the nature of both true cysts and of these envelopes of the new growths, if the word "cyst" was exclusively restricted to a circumscribed cell or cavity bounded on all sides by a continuous membrane. In these adenoid growths, for the most part, it is the envelope or capsule of the new growth detached from its surface by the accumulation of fluid simply, which constitutes the so-called cyst. As this fluid is either absorbed or not secreted, the growth seems to encroach upon, or fill up and obliterate the cyst; but without the growth increasing, if the fluid disappears, the capsule becomes compressed upon the surface of the new growth, and is more or less adherent to it.

nodule upon the cutaneous surface of the breast, in its substance, at its border, or behind it. In some instances their mobility and isolation from the organ are aids towards diagnostication: but when they are imbedded in the gland, or developed behind it, these features are not recognizable. When the new growth has reached a considerable size, the true breast is frequently atrophied. Rarely both the right and left breast have tumors developed in them, and it is uncommon to meet with two or more in the same organ. We have been unable to prove that one breast is more liable to this affection than the other. A patient was, however, under my observation, in whose breasts numerous tumors were developed, varying in size from half an inch in diameter to two or three inches. The rapidity of their growth varies greatly in different patients. Those possessing a cystoid character increase more rapidly, as a rule, than the dense, compact, fibrous structures. In several museums enormous masses of all kinds are preserved, which weigh many pounds. The integuments usually accommodate themselves to the stretching to which they are subjected without ulceration taking place, although in some few instances we have seen them become gradually thinner and thinner over a single cyst, and ulcerate. This allows the escape of the serum, after which a hole continues in the skin, the features of which are distinctive of the disease beneath. The edges of the ulcer are thin and lie flat upon the intra-capsular growths, neither inverted nor everted; they are not even adherent to it, but can be raised from it with facility. In one instance, and where the tumor was not large, the integuments sloughed, after which the whole mass projected through the opening in the skin and formed a red fungating growth, which assumed the aspect of cancer. As a rule, the more dense and fibrous kinds grow slowly. I lately removed one of twenty-five years' growth which was only about four inches in diameter. When in the gland of a young girl, their rate of progress seems commonly to be from about half an inch to one inch in twelve months. Such, at least, is the nearest estimate I can form, after watching them in patients who would not submit to their removal. Having attained a moderate size, their growth sometimes ceases. Those tumors associated with cysts always grow the fastest. One notable exception to this we have observed. It occurred in a maiden, twenty-three years old, from whom Mr. Nathaniel Ward removed a tumor of two pounds weight, which had grown in about eight weeks, according to the statement of the patient. It was chiefly composed of succulent fibre-tissue and the epithelium of the mammary gland-ducts and cæci.

Fig. 925.

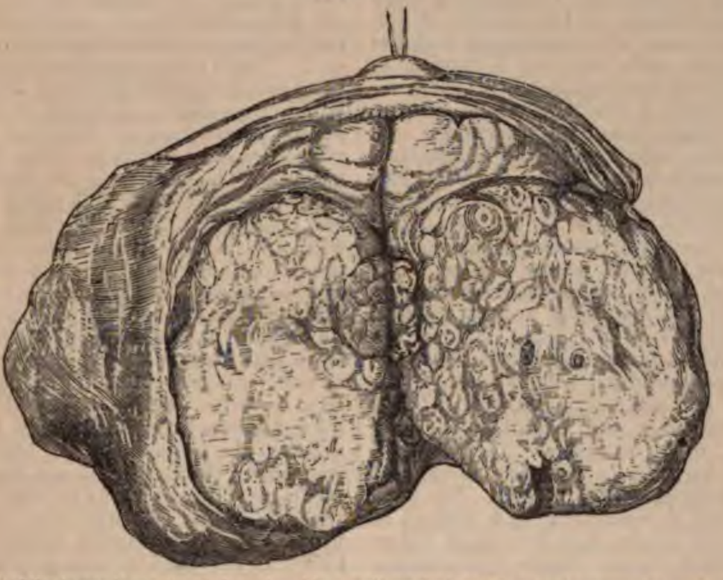


The woodcut represents a fine example of the combination of the solid and cystiform growths developed in the breast of a middle-aged woman. The whole tumor was very large, and was removed by Mr. Aston Key. The wasted mammary gland overlies the growth on its left, and the nipple and ducts are indicated by the letters *a*, *b*. At the right of the tumor the integuments had ulcerated, and the letter *c* points to the growth projecting slightly through the hole in them. The drawing and preparation are in the museum at Guy's Hospital—No. 402^{75}; 2294.

Sudden and rapid increase in size occasionally happens in these cases, accompanied with more or less redness and vascular congestion of the cutaneous covering. This change is due to two causes operating upon the tissues of the new growth. One is inflammation, passing on to destruction or necrosis of its central portions; the other depends upon intracapsular hemorrhage. A case of this kind is reported by Mr. Bryant.[1] In another case,[2] under the care of Mr. Kellock and the writer, a sudden enlargement of the tumor was observed a few days before parturition. The growth was of several years' development; and when removed a large cyst was found in it, containing a mixture of milk and serum.

Growths of the firm, fibrous kind are frequently developed behind the true gland, which is atrophied. The accompanying woodcut displays the arrangement of the tumor thus disposed. It was formed behind the wasted breast of a single woman, forty-three years old, and had been observed about three months. The removal of this tumor was effected fifteen years since, and the patient is at this time quite well.

Fig. 926.



A section of the tumor is represented, enclosed in a well-marked envelope. Overlying it, and also on its left side, is the atrophied breast, and at the top the nipple is seen, with two bristles projecting from the mouths of the ducts. A colored drawing and the preparation are now in the museum at Guy's Hospital. Drawing 404^{5}; preparation 2299^{50}.

These tumors are developed at any age, about puberty or subsequently. Sometimes they form simultaneously with the development of the gland, rarely with the changes taking place during pregnancy, but most frequently at the stage of passive maturity of the breast. Thus, of any large number of cases, the third decade of life, which includes the ages between twenty and thirty years, offers the majority of examples. But care must be taken to note the age of each individual at which the tumor was first observed, and not that at the moment of examination. The writer found the proportions to be as follows, in 125 cases, from birth to fifty years old. During the first ten years there was not a case; from ten years to thirty, 90 cases; from thirty to fifty, 35. In a very large majority of cases, the women were single when the tumor was first noticed; and when married women were the sufferers, the majority had been prolific. The patients were generally remarkably healthy. Very little inconvenience is caused by the growth in its early stage; indeed, very often the patient is only made aware of its existence by accidentally touching it. In a very few cases the discovery of the "lump" was preceded by a contusion. Just before the catamenial period a little pain may be felt; but that, perhaps, does not exceed the usual irritability of the organ prior to its recurrence. Even when of great magnitude and their bulk intolerable, the freedom from pain is remarkable. It is right, however, to state that in a few cases we have known the patient to complain of severe pain; and that, in one instance, with this accompaniment, a filament of a nerve was traced into the new growth. The general health of the sufferer is unaffected in the first instance; but at last the bulk of the growth, and the mental anguish induced by anticipation of its results or necessity for an operation, prey upon the constitutional vigor of the patient, and it becomes impaired, whilst, at the same time, the facial aspect is indicative of depression and anxiety.

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[1] Trans. Path. Soc., vol. xii., p. 222.

[2] Ibid., vol. ix., p. 386.

[The tumors classed together by Mr. Birkett, under the term "adenoma," are divided by more recent pathologists into several groups. The true adenoma is exceedingly rare, and consists of glandular structure closely resembling that of the normal breast. The more systematic arrangement of the epithelium in acini lined with an unbroken membrana propria distinguishes the adenoma from cancer, in which the epithelium penetrates the acinous wall and invades the surrounding structures. Cystic adenomata are characterized by the growth of epithelium in acini with subsequent liquefaction of the cells and the formation of cavities lined with epithelium. The connective tissue in this kind of tumor is not given to sarcomatous degeneration. In the cystic sarcomata, the connective-tissue proliferation is the essential element in the formation of the tumor, and the epithelial growth is but secondary and the result of irritation. The cavities consist for the most part of dilated ducts and acini, which have been drawn out of shape by the enormous growth of their connective-tissue envelopes. The pathology of these tumors is, however, not well understood, and all the various groups demand new and thorough investigation.]

Of recurrence and alteration of these growths after removal.—The growths classed together in the first group very rarely reappear after excision. We have never seen a recurrence in a patient in whom the tumor was developed before thirty years of age. But in older women, and especially when the tumor resembles those constituting the second group, recurrence is not infrequent, particularly if the entire mammary gland has not been carefully removed with the tumor. The truth is, that the more closely the tissues of these growths resemble the elements of the fibro-plastic formations, the greater will be the probability of their reappearance locally, and, we may also add, in one or other of the internal organs. An interesting feature of those cases in which the mammary growth has been repeated, consists in the varieties of the first and second groups alternating with each other. For example, the first growth may be solid, firm, fibrous, and its section resembling the cut surface of the mammary gland; but the second tumor shall have the cystoid formation; whilst a third may assume all the characteristics of the first. And often, in different portions of the same tumor, these growths are found associated together, invested by a common envelope. Do we not in these loosely constructed growths recognize the propriety of applying the term "capsule" to the fibrous membrane surrounding the adenoid growth, rather than adhering to the word "cyst," which carries one away from the relations really subsisting between the capsule and the new growth within it?[1]

Diagnosis.—The age of the patient and her healthy aspect; the shape of the breast, the locality of the growth, in many instances, its firmness, mobility, and freedom from pain, except perhaps after pressure,—are the chief points from which aid is derived in correctly diagnosticating the fibrous compact varieties of adenocele, developed in the breast of maidens *before* thirty years of age. After this period, the cystoid varieties most commonly prevail. These tumors are characterized by their nodulated and lobulated surface, in which irregularity of course the integuments participate, so that the uniform roundness of the surface of the breast is marred. The elevations and depressions correspond with the collections of fluid and masses of solid new growth. Often when the finger is pressed over the most prominent, the fluid can be displaced, and the indented surface of the intra-capsular growth detected by sight as well as by touch. A combination of these capsules with their solid contents, in larger or smaller masses, together with perfectly solid growths, can be diagnosticated by manipulation. In some cases the bold relief of the tumor upon the thorax, and its striking projection against the integuments, as if it were ready to burst through them, is highly characteristic, especially in marking the important distinction between an independent new growth developed in the organ and those new formations which, infiltrating the tissues of the gland, do not essentially interfere with its normal outline.

The *prognosis* of this tumor is for the most part favorable. When the growth belongs to the first group it is always so. But when the fibro-plastic elementary tissues appear, the surgeon must bear in mind the statements before made, and pronounce with caution.

The *treatment* consists in removing the tumor by excision. We have never seen the slightest advantage gained by local applications, nor are we disposed to admit that a genuine new growth of the nature before described is ever absorbed. Isolated and circumscribed lobules of the true gland, which from their hardness and mobility closely resemble these new growths, certainly disappear when the healthy condition of the gland is restored; but is a genuine new growth ever absorbed? We believe not.

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[1] Brevity being compulsory, the reader is referred to a paper on adenocele in Guy's Hospital Reports, 1855, in which a large number of cases is reported by the writer.

On small tumors the operation is very simple. The integument should be stretched over the growth tightly, and the point of the scalpel inserted sufficiently deep to penetrate its anterior surface to the depth of about a quarter of an inch. The capsule is thus cut by drawing the edge of the scalpel through it. Its handle is next made use of to detach the connections between the capsule and the growth, and where the fibrous tissue enters between its component lobes the blade is used. After this manner it is easily enucleated, without cutting the breast-gland itself. When the adenocele is covered anteriorly by the gland-tissue, the operator must make an incision through that structure, and open the capsule as before described. The edges of the wound are to be kept in close apposition with plaster. This proceeding should be adopted in the majority of patients under thirty years of age. As a rule, however large the growth, the gland should be sought out and preserved, if practicable, in young childbearing women.[1] After thirty-five, unless in exceptional cases, we deem it preferable to remove the entire breast with the growth.

Duct-cysts.—Perfectly closed cysts, and others so called, but having an opening communicating with a duct, which in some instances is so large that the swelling assumes rather the character of a dilatation or bulging of the walls of the tube, are frequently met with in the breast. Their contents more or less closely resemble the mucoid secretion found in dilated ducts. Hence their assumed origin and the term by which they are designated, duct-cysts, retention-cysts; or, from the nature of their contents, mucous cysts.

The wall of the cyst is usually thin, firmly united to the surrounding parts, and consists of fibre-tissue. Its interior is smooth, and covered with squamous epithelium. The contents are either a thick tenacious mucus, of a dull green, yellowish, or brownish tint, and slimy, greasy consistence, which renders water turbid, but does not readily mix with it; or, if the cyst be large, the fluid is more serous, with an admixture of blood, causing its color to assume a dark red, brown, or blackish hue. Laminæ of cholesterine often float in the fluid. Sometimes only a single cyst forms in one breast; in other cases cysts abound in one or both. Indeed, one rarely fails to find some of them of minute size, if the gland of a woman of middle age and who has suckled several children be examined after death. Of course, examples of this kind give no trouble; but when the tumor reaches one or two inches in diameter, and produces a hard, fluctuating swelling in the breast and a blood-colored fluid oozes from the nipple, considerable alarm becomes excited. Such swellings are developed in any part of the breast. Most commonly, however, when large they are placed superficially, near the areola, and in the neighborhood of the larger ducts. When numerous and minute, the posterior and peripheral regions of the gland seem to be the parts usually selected for their development.

This disease is always met with in the passive state of the gland, and in adults who have reached or passed the middle period of life. It occasionally occurs in single women, but most commonly in those who have been mothers and suckled children; although married but sterile women are not exempted. In different cases and at various stages of the growth, the accompanying pain differs much. In some, this morbid condition is painless. When the cyst is very large—a condition which, however, rarely happens — the fluctuation of its fluid contents is very distinct; and when small and numerous, the same may be detected in the separate cysts, although they often feel so very hard as to deceive the careless observer. By gentle compression of the cyst the fluid sometimes escapes from the nipple, which occurrence may almost be accepted as pathognomonic of this disease, and especially, too, if the cyst can be thus entirely emptied. But should a solid substance be felt after the escape of the fluid, the probability is that some other disease exists, associated with the cyst. As the cyst enlarges, the integuments covering it become thinner and thinner, until the colored fluid it contains produces discoloration of the skin. Such altered color of the integumentary texture, from that circumstance alone, is a notable fact, and one which must not be confused with the color depending upon congestion of its bloodvessels, or infiltration by inflammatory or other products. The tint of the overlying skin is either pink, red, purple, or brown. At length ulceration of the skin takes place, if the disease be allowed to take its course, and the fluid contents of the cyst escape. In some cases the opening heals: but as the wall of the cyst remains, it soon becomes again distended with an accumulation of fluid. We have known this operation to be repeated over and over again, occupying a period of several years, and merely giving rise to trouble and annoyance.

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[1] The reader is referred to Mr. Stanley's case, preparation No. 208, in the Pathological Museum at the Royal College of Surgeons; the report of the case in Guy's Hospital Reports, 1841, p. 203; and its subsequent history in the volume for 1855, p. 144, case v. Also another case, with a milk cyst, p. 139, case i., in the same book. This last-mentioned patient is now well.

[The doubts which Billroth has expressed regarding the origin of these so-called retention-cysts, must be shared by every one who has studied their histological and clinical histories. They occur most frequently in breasts whose secreting structure has atrophied, and which have been quiescent for years. A retention of normal secretion is therefore for the most part out of the question. The ordinarily accepted theory that they arise from the softening or liquefaction of epithelium in closed canals, has been by no means satisfactorily established. Their frequent occurrence in connection with cancer—in my practice, a most striking feature in their clinical history — suggests almost irresistibly, that they owe their being, in some cases, any way, to the action of the same unknown abnormal force which produces cancer. In cancer, the acinous epithelium, which in the involuting gland ought to atrophy and disappear, multiplies with abnormal vigor, breaks through the membrana propria, and involves the surrounding tissues. It is not difficult to conceive that a less powerful impulse in the same direction might also stimulate the proliferation of epithelial cells, which, less vigorous, would speedily undergo liquefaction. In such a case, the term retention-cyst would be a misnomer, as they would more properly belong to the class of cysts formed by the softening of tissue.]

This disease being of purely local origin, and usually occurring at a period of life when the organ is no longer required, two methods of treatment are offered for selection. The palliative treatment consists either in emptying the cyst by compression, when its contents flow freely from the nipple, or by making use of a trocar and canula for the same purpose. When several cysts exist, a radical cure can only be effected by the removal of the entire breast. If only one cyst, incision and exciting inflammation of its walls will cure it. All external local applications are unavailing for the cure of the disease; but if a single closed cyst exist, it may be emptied, and a drachm or less of the tincture of iodine injected and allowed to remain there. Obliteration of the cavity sometimes follows this treatment. When the disease originates as above described, to the exclusion of every other, the prognosis is favorable; but it cannot be denied that a great tendency to the development of these cysts exists in association with carcinoma. In certain cases, therefore, a guarded prognosis is desirable. Preparations illustrating this disease are to be seen in the College Museum, Nos. 2742, 2744; and in Guy's Museum, Nos. 2290^{55}, 2290^{63}, and 2290^{70}.

Galactocele—a milky tumor, or a swelling caused by rupture of the milk-tubes and escape of their contents into the surrounding connective-tissue, or dilatation of a lacteal duct or its sinus from obstruction—is rather a rare disease, and always developed during the active state of the organ. If it occur at an early period of lactation, and in consequence of rupture of a large duct or of one of the sinuses, fluctuation is perceptible in the tumor, which forms quickly and increases rapidly and distinctly during every time the infant sucks. On the other hand, should the extravasation proceed slowly, but little observation is taken of it: and having attained variable dimensions, the tumor sometimes remains without alteration for some time.

These cases being rare, the following instance is here introduced. A very healthy-looking married woman was twenty-two years old when her first child was born. Soon afterwards a tumor formed in the left breast, which after five months' duration was punctured, and serum escaped. She did not suckle with that breast. She gave birth to six more children, and at each parturition the tumor increased in size, but diminished as soon as lactation ceased. She came to me with a tumor of thirteen years' duration. It was soft, globular, and somewhat nodulated. An incision was made into it, when ten ounces of thick cream flowed away. The wound quickly closed by granulation.

The serous portions of the milk being absorbed slowly, the more solid, fatty constituents remain, causing the swelling to decrease and to become firmer. It may at last feel quite hard, the cyst-wall becoming rigid and crisp, which depends upon the deposition of earthy salts. In this stage a difficulty may arise in distinguishing the precise nature of the tumor. The swelling, during its formation and subsequent progress, is unattended with pain; the color of the overlying integuments is unchanged, and the general health is not affected.

The diagnostication of the swelling is made, when first formed, by calling to mind the condition of the organ at the moment of its development; its sudden formation during suckling, and the changes produced in it concurrently with that act; the fluctuation; the unaltered color of the integuments; and the freedom from constitutional disturbance. At a later period, the surgeon must be guided by the history of the case, its negative indications, his experience of other tumors in the breast, and by manipulation.

[The contents of galactoceles to the naked eye appear often so like pus that only the microscope can determine the diagnosis. It is my opinion that they are, on this account, believed to be much more rare than is really the case, being frequently mistaken for chronic abscess. My experience leads me to believe that they are of by no means rare occurrence.]

The treatment consists in incising the integuments and the cyst, allowing the free escape of its contents, and exciting the wound to heal by granulation.

A preparation showing the lactiferous tubes dilated and filled with milk is preserved in the College Museum, No. 2741; and others, showing a cyst which contained milk, in Guy's Museum, No. 2290^{80}, one a mass of casein, 2299^{40}, and 2290^{50}.

Sero-cysts are characterized by the nature of their contents, the globular outline of their form, the simplicity of their structure, and their harmless influence. The cysts so commonly found associated with the new growths termed adenocele are designedly excluded from this category, as their contents are peculiar and characteristic.

The fluid of the true sero-cyst is limpid, and nearly colorless, or very pale yellow, or light brown, and sometimes just tinted with the coloring-matter of the blood. It is clear, occasionally very slightly turbid, and never tenacious. It shows an alkaline reaction. Neither the application of heat, unless the fluid be very alkaline, nor the admixture of nitric acid, cause any coagulation, although a very slight flocculent precipitate may subside as the liquor cools. The cyst-wall is very thin, composed of fibre tissue, firmly attached to the surrounding parts and lined with squamous epithelium. It is always perfectly closed, and never communicates with a duct. Usually a single cyst only is found. Its existence is discovered by the patient, whose attention is drawn to a painful spot, perhaps, where the finger detects a small hard "lump." This discovery may have been made some time after the receipt of a contusion in the region, which merely produced temporary pain, and was subsequently forgotten. Other cases have occurred, for which the patient was totally unable to assign any local cause. As the fluid slowly accumulates the tumor progressively enlarges, and if seated superficially, elevates the skin, producing, therefore, unusual fulness of the affected organ. If it be near the nipple, that organ is sometimes pushed aside; and if the maiden state of it exists, it may be flattened out and lost to touch, although traceable by sight. It is never really retracted. The skin at last becomes much stretched over the tumor, without showing any other marked structural change, and by a careful adjustment of a strong light, the surface of the swelling appears translucent. Fluctuation is now distinct, together with the characteristic vibration of a circumscribed collection of fluid when gently and suddenly tapped with the finger. By degrees, the pressure of the fluid acting upon the skin, its vessels become congested, and sometimes its capillaries dilated; but there is little really inflammatory action until the last moment. Then ulceration takes place at a very small spot, the fluid flows out, the cyst collapses, and a serous scarcely-colored discharge continues to escape. That aperture sometimes closes, and never reopens; in other cases, the processes above described are all repeated. These cysts are developed at a somewhat earlier age than those termed "duct-cysts"—between forty and fifty. They are generally painless; but in nervous irritable women they are sometimes described as being painful. The general health is undisturbed, and the catamenial function normal.

The treatment consists in emptying the cyst with a trocar and canula, after which an embrocation may be applied over the part, consisting of hydrochlorate of ammonia, spirits of wine, and camphor-mixture. Sir B. Brodie states[1] that he has cured cases, probably of this kind, by the mere application of a lotion composed as follows: ℞ Sp. camph. sp. tenuior., ana. fl. oz. iijss; liq. plumb. diacet. fl. oz. j. This must be applied on a piece of flannel, once folded, over the site of the tumor, renewing it six or eight times in the day and night, until the skin becomes inflamed; then desisting for two or three days, and again using it. He adds that "three or four weeks," and in some cases "some months," elapse before this treatment is successful in effecting a cure. In eighteen cases which I have myself treated, a single puncture, as above described, was sufficient to produce a cure.

Lipoma and excess of fat.—Masses of adipose tissue are occasionally developed on the breast, within it, and sometimes behind it. As age advances, fat is frequently generated in the place of the gland-tissue, so that what appears to be a largely developed organ, really consists of fat-tissue only, through which a few ducts radiate from the nipple.

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[1] Lectures illustrative of various subjects in Pathology and Surgery, 8vo., 1846, Lect. vii., p. 156.

But in early life, tumors composed of fat (true lipoma) have been removed from the breast.[1]

Mr. Roper, of Croydon, sent to the Museum at Guy's Hospital several pounds of fat (preparation 2300^{80}) which had been growing in the site of the mammary gland for fifty-eight years. A tumor was first noticed by the woman in her thirtieth year. She died at the age of eighty-seven years, having been merely troubled with the bulk of this pendulous tumor, which measured twenty-three inches around its largest circumference. In its centre there was an irregularly-shaped piece of bone. The same collection contains a portrait of the patient and tumor taken during life.

At an early age, and in persons disposed to obesity, these organs become enormously loaded with fat.

Vascular growths, very rarely met with pure, are generally associated with carcinoma. That is to say, the new growth contains a large number of vessels, and bleeds freely when wounded. The case published in the Medico-Chirurgical Transactions (vol. xxx.), which is reported by Mr. Image, may be referred to. There is also a case related in the American Journal of Medical Sciences, No. xxxv.

Neuromata are developed on the cutaneous nerve-filaments, as well as probably on those within the breast. Their presence is recognized by the usual indications, which require no special mention here.

Enchondroma and osteoid growths.—New growths of tissues resembling those constituting special systems of the body are very rarely found in the breast. Thus it is extremely uncommon to meet with tumors composed of either cartilage or bone.

Sir Astley Cooper relates the case of a woman, thirty-two years old, who had observed a tumor in her breast for fourteen years. When removed, the growth consisted of two portions: "the larger portion of it had the appearance of that cartilage which supplies the place of bone in the young subject; the remaining part was ossified." Also Prof. J. Müller writes,[1] in reference to four cases of enchondroma: "In all of these four cases the parts affected were glandular structures, namely, in one instance the parotid gland, in another the *mammary gland*, and in the remaining two the testicle." (Dr. West's trans., p. 102).

In old books we find reports of cases in which bony masses or concretions have been found. In old women, and in cases of extreme atrophy of the breast, the arteries are not uncommonly converted into bony tubes: see preparations in the Museum of the Royal College of Surgeons, 2811, 2812, and one in Guy's Hospital Museum. Of earthy concretions there are several preparations in the Museum of the College (Path. Cat., vol. iv., p. 342).

SPECIAL DISEASES. DIVISION III.

NEW GROWTHS COMPOSED OF ELEMENTS FOREIGN TO THE NORMAL TISSUES OF THE BODY.

Hydatid cysts.—Cysts containing entozoa are occasionally met with in the breast.

Two cases have been seen by the writer. One of them occurred in a woman fifty-one years old; the other was twenty-nine at the time of the operation for the removal of the disease. Both were patients in the hospital. In the elder of the two the swelling in the breast had existed eleven years; in the other one six years. They both enjoyed very good health. The tumors measured about three inches in diameter; they were distinctly circumscribed, firm, painful when pressed, and fluctuation was very distinct. In one case Mr. B. Cooper removed the whole breast, together with the tumor; in the other, Mr. Cooper Forster removed the cyst and its contents only. The large sac containing numerous globular hydatids was very characteristic, and with the aid of the microscope the tentacles of echinococcus hominis were apparent in both instances. We are unable to distinguish between these cysts containing entozoa and others filled with serum or even pus; but the length of time which the tumors have existed, their slow increase, and painless nature, together with the negative evidence to be acquired by sight, touch, and the history of the case, should dispose the surgeon to open the cyst freely before cutting off the whole breast.

Fibro-plastic growths.—Under this term we include a class of new formations, the elements of which are nucleated cells of a fusiform or oval shape. The tumor increases rapidly, and becomes much identified with the breast, although the gland-tissue is not infiltrated with the new elementary structures; the integuments ulcerate, and allow a fungating, sprouting growth to burst through the opening. This disease is very commonly developed in the breast. Sometimes it is associated with adenoid growths, and springs up in the gland of rather youthful women, who seem to be in the enjoyment of remarkably good health. Judging from the cases which have fallen under the observation of the writer, the recurrence of the growth is almost certain to ensue after removal, and the probability of the viscera of either the thorax or abdomen containing identical growths is almost equally great. It chiefly differs from the adenoid tissues in being developed at a rather later period of life, in the rapidity of its development, and by assuming externally some of the appearances of carcinoma. In truth it has not perhaps sufficiently characteristic external indications to enable a surgeon to distinguish between it and carcinoma during its growth, but its elementary constituents differ widely from those of carcinoma. When not interfered with, the tumor often attains enormous proportions, and sometimes the centre softens down, or the whole mass sloughs. It is more vascular and succulent than carcinoma, and when ulcerated often bleeds profusely. The glands of the lymphatic system of the breast are not involved in the disease, even at the latest period. In our experience the removal of the growth has only been attended with temporary advantage, yet we do not hesitate to sanction this step, as it is the only one by which the patient has a chance of being saved from acute local suffering and a speedy death.

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[1] Remarkable cases of lipoma are recorded, as follows: Sir A. Cooper removed more than fourteen pounds of fat, Illustrations of the Diseases of the Breast, p. 67; and another case, p. 68. Sir B. Brodie relates a case in Lectures on Pathology and Surgery, p. 271. Warren excised eight pounds of fat; On Tumors, p. 228.

[1] Ueber d. feinern Bau u. d. Formen d. krankhaften Geschwülste; fol., Berlin, 1838.

Colloid growth.—This new formation, termed by Prof. Müller "collonema" and "carcinoma alveolare," is very rarely found in tumors of the mammary gland. In outward appearance, the new growth termed by Virchow "myxoma" closely resembles this one. Most specimens of the disease have been taken from other parts of the body. We have seen but two examples on living persons, and there was nothing sufficiently characteristic then to lead to its identification. But it is quite the contrary when a section of such a growth is examined. There is not one so marked, so distinct, so easily recognizable. The transparent jelly-like substance is arranged in compartments, the walls of which are formed of a delicate fibre-tissue. In the specimens we have seen the color has differed, but that has merely been owing to the admixture of the coloring matter of the blood. Very little change takes place in the appearance of the section after immersion in dilute rectified spirits of wine, but the jelly oozes out slightly and projects from the alveoli, forming a delicate flocculent surface. There seems to be a tendency to local recurrence in these growths, and therefore the whole of the affected organ should be removed; especially, too, as preparations show that isolated centres of the growths are disseminated freely around the principal mass.

Carcinoma, a disease generally known by the term "cancer," is more commonly developed in the breast than any other growth. It is found under three very distinct forms. First, the infiltrating kind; secondly, the tuberous; thirdly, the cystiform, or associated with a cyst or cysts.

In the first variety, the normal tissues of the breast, whether in a healthy condition of passive maturity or more or less atrophied, appear to be infiltrated with a fluid and nucleated cells. If the diseased organ be examined at this stage, its appearance, to the unassisted eye, differs but slightly from that of a gland affected with chronic induration; that is to say, it is hard, condensed, incompressible, and sometimes rather granular on the surface of the section. When the part is examined by the aid of the microscope, the nucleated cells, identical with those found in tumors generally acknowledged to be cancer, are easily seen in the fluid oozing from the tissues. In thin sections of such a diseased breast, these nucleated cells are found to be arranged in small groups, between the fibres or stroma of the organ. This stage of cancer has often deceived superficial observers; for cases of this kind have been recorded in which, after the removal of a tumor not recognized to be cancer, that disease has subsequently developed and killed the patient. The entire gland, or a single lobe, may be thus infiltrated. After the lapse of time, the diseased tissues lose their identity, and they become harder, compact, and of a uniform grayish tint. They no longer maintain any resemblance to the section of a mammary gland, although, perhaps, a few ducts may be indistinctly traced. The next marked change is that which is chiefly characterized by the contraction of the growth. The tumor is now as hard as a stone. It may be crushed by pressure, scarcely torn. The surrounding textures, not those of the breast only, are drawn towards it, for it seems to have formed a sort of nucleus or centre, dragging all the neighboring parts together. Upon the cut surface of such a tumor the remains of the ducts are often traceable, forming a finely reticulated figure. This is carcinoma scirrhosum, or the scirrhous cancer, or "stone cancer" of old writers and the public; carcinoma fibrosum of more recent authors.

The changes before described, which take place in the infiltrating variety of cancer, may often be observed in the different masses of the same gland after its removal. Thus in one part where the tumor has existed the longest time, and over which the integuments are dimpled or puckered, the gland-structure will be found to be entirely destroyed, and just a trace of ducts perceptible. In this part the active growth of the disease would appear to have become arrested, its progress terminated. We often meet with cases in which the entire gland, having been at one time so infiltrated (in which case the disease usually commences in the centre of the organ), subsides into a mere hard nodule, and gives little trouble, if any at all. In another part, the gland-tissue has lost its characteristic features. The ducts are traceable into it, however, and it may still retain an indistinct lobulation. All the interstitial fat has disappeared. The disease has here been growing a comparatively short time, and in sections of such a tumor the elementary structures of carcinoma are well seen. At another part, the section of the gland-tissue appears to be merely indurated, its lobulation is marked, and small lobules of fat are still interspersed. The condition of this portion is the result of quite a recent change. It is due to the earliest stage of infiltration, and the elements of cancer-growths exist there. Thus these three stages of infiltrating carcinoma may be clearly demonstrated in different regions of the same breast, as well as in three separate glands removed from three distinct individuals. We have not space to give here a description of the minute anatomy of these growths at the three stages above described; but it should be stated that their elementary structures, invisible without the aid of a microscope, are quite as characteristic as the appearances to the ordinary vision.

The tuberous variety of carcinoma forms a distinct tuber or circumscribed mass in the breast, quite within its fascial envelope. Its synonyms are numerous. Thus, if soft and brainlike, C. medullare or cerebriform; if firm and solid, solanoid; if jelly-like, gelatiniform; when black, it is called melanic or melanotic. Having ulcerated through the integuments, it is called fungoid; and if profuse hemorrhage supervene, the term fungus hæmatodes has been employed to mark the fact. But the single feature which most distinctly characterizes this form of carcinoma is its isolation from the gland-tissues by means of a more or less well-defined membranous capsule. Thus the tissues of the breast itself are pushed aside by the encroachment of the new growth, and, as they are not at first absorbed, the dimensions of the affected organ, in comparison with the healthy one, accord with the progressively increasing development of new tissue. Contraction, a feature so characteristic of infiltrating cancer, does not occur in this variety. Therefore the progress of tuberous cancer more or less rapidly advances, in the majority of cases, to the formation of a tumor of considerable dimensions. Distinct and separate nuclei of tubers are occasionally developed in different parts of the same breast. By degrees they coalesce, and form one large growth. Again, the tissues of a single tuber will occasionally burst through their envelope, as it were, and form a very large lobulated mass, which separates the breast into several divisions.

The cystiform variety of carcinoma, or a growth of cancer-tissue associated with a collection of fluid circumscribed by a fibrous capsule or cyst, scarcely possesses sufficient individuality to allow of its admission as a distinct *species*, though its *form* is distinct. The solid growth belongs usually to the tuberous form, and the collection of fluid which always bathes a larger or smaller portion of its surface is really but an accidental formation. In morbid structures of this nature, the cyst seems to have attracted the notice of anatomists in a more marked degree than the solid growth. Thus we continually meet with the expression, "the growth from the cyst-wall," whereas, when cases of this description are watched during the growth of the disease, the collection of fluid is often progressively formed upon the surface of a solid tumor. In such a case, the cyst which circumscribes the fluid is a secondary formation, and the solid growth was the cause of its development in the following manner. All surgeons must have observed the quantity of serous fluid poured out from tubers of cancer over which the integuments have ulcerated. This serum flows away, in the absence of anything to allow of its accumulation. But let the fluid ooze from a growth of cancer surrounded by a fibrous envelope, and it will collect, when in excess, between the envelope and the growth, and, separating the capsule further and further, a larger and larger cyst will be developed. Now, if such a tumor be removed, and the walls of the cyst cut open opposite to the growth, the membranous structure falls collapsed, and a solid substance seems to bud forth from its tissues. But make such a single section of the tumor as shall divide the capsule and growth into symmetrical halves, and then the relations of the solid growth to the envelope of the fluid will be visible. The observer will notice that he has before him the section of a solid growth of cancer, limited by a more or less distinct membrane, and united with the surrounding tissues of the breast. The "cyst" will now appear in a different relation. It may be traced in continuation with the fibrous envelope of the tumor, which is, however, more delicate than it, but clearly identical. The surface of the growth, bathed by the serum, has not this envelope; for it has been separated from it by the continual oozing which has taken place, at the same time becoming thicker. Thus the only peculiarity possessed by such a growth of cancer is the addition to some part of its surface of an accumulation of serum in a fibrous capsule. The serum is generally deeply tinged of a brown tint. It is often quite clear. After standing a few hours in a test-tube, blood-discs are precipitated. Heat, or nitric acid, being applied, more or less turbidity or coagulation takes place. After the serum has been removed through a canula, it generally rapidly collects again. This variety of cancer long ago attracted the attention of surgeons, and several writers have alluded to such cases under the title of "bloody cysts in cancerous breasts."

Age when carcinoma is most commonly developed.—The fifth decade of life is that in which carcinoma is most frequently developed in the breast; that is, from the 40th to the 50th year. Before 20 years of age the writer has never seen a case.[1]

The table below shows the proportion of cases at various ages. Most of the cases were under the observation of the writer; they have not been in any way selected by him, and great care was taken to note the age at which the disease was first observed:—

Age from	20 to 30	years	19
"	30 to 40	"	100
"	40 to 50	"	193
"	50 to 60	"	97
"	60 to 70	"	34
"	70 to 80	"	6
"	80 to 90	"	7
"	90 to 100	"	2
			458

Even taking into the calculation the disproportion of individuals alive at any definite periods, the numerical proportion here given shows that an excess of cases belongs to the fifth decade; for only 36 less than half the total number appear in those ten years, or rather more than two-fifths against all the cases at other ages.

The constitutional nutrition of persons afflicted with carcinoma varies, at the development of the disease, between the appearances of robust health and general cachexia. In some cases late in its progress, or even in the last stages, its ravages upon the general health are not very apparent. Some writers assert that, if careful inquiries be made, it will be in most cases ascertained that the state of the general health has been below the average healthy standard for some time previous to the discovery of the disease. But, after the most careful researches in reference to this most important point, the writer has been unable to arrive at any definite results. The statement may certainly be made, without fear of contradiction, that all circumstances tending to depress the vital powers are very commonly associated with the development of cancer. Thus severe mental distress, losses of blood, poverty, intemperance, are commonly marked features in the history of the lives of individuals afflicted with this disease. Still, who would be bold enough to assert, after much experience of the vicissitudes of social life, or of the habits of the people, that these are predisposing causes to its development? Surely, if they were, the disease would be even much more common than it is.

To the cessation of the catamenial function it is usual to refer some baneful influence, and thus to associate cancer with this natural result. But, after careful inquiry, it is found that, of any given number of cases, in a large majority of the women the function is persistent at the moment of the development of the disease. Thus, abstracting this fact from a hundred cases, not selected, but as they chanced to come under observation, we found that the catamenia were persistent in 70, and that the function had ceased in 30 only. Again, the foregoing table of various ages shows that the largest number of cases occur between thirty and fifty years, during which period this function is active, admitting its cessation about the forty-fifth year as an average.

Unmarried women are said to be more prone to cancer of the breast than the married, and sterile women rather than prolific. The following facts, derived from an examination of a hundred cases, prove the fallacy of such assertions. Thus, of 100 females suffering with cancer, 86 were married, 14 were single. Of the 86 married women, 73 were prolific, 4 had aborted, and 9 were sterile. As regards lactation, the writer has failed in establishing any marked relation between the imperfect performance of this function and the subsequent development of cancer. It is a notable fact, especially in relation to diagnosis, that cancer is very rarely developed during pregnancy or suckling.

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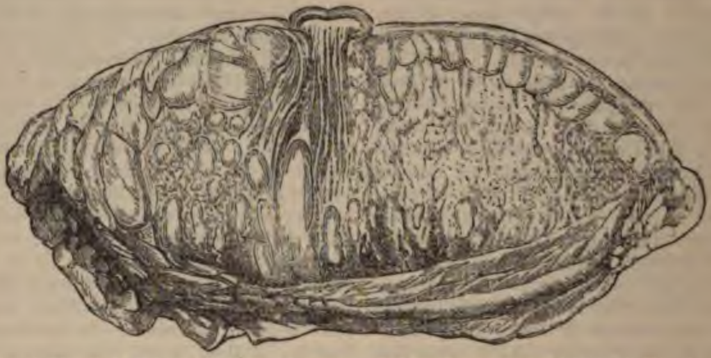
[1] Mr. Lyford (Lancet, vol. xii., p. 332) and Mr. B. B. Cooper (Lectures on Surgery, 8vo., 1851) each record a case; the former at eight years of age, the latter at thirteen. In the Museum of St. Bartholomew's Hospital, the preparation, ser. xxxiv., 4, was removed from a girl aged sixteen years.

The primary development is usually observed in the substance of the breast, upon its surface or at its periphery. The patient very frequently accidentally discovers the hardness first by the touch, neither pain nor uneasiness in the part having been experienced. When the growth is seated at the margins of the gland, or upon its surface, it is frequently very movable, circumscribed, and distinct. If, however, lobular infiltration exists, the tumor seems to form an integral portion of the breast, and its isolation from the surrounding structures is impracticable. Diseased gland-tissue and healthy seem to be inseparably blended together. Often, if the infiltration involves the central portion of the breast, the whole organ feels merely indurated, and is perhaps unaltered in shape. At this early stage there is usually very slight change in form. Unless the patient be very thin, there is no visible sign of the tumor. We assume, at this time, that its dimensions do not exceed two inches in diameter. The progress of the infiltrating variety of the disease may be wholly confined to the breast throughout the remainder of the life of the patient. In such a case the gland-tissue having been destroyed by the new growth, contraction takes place; and the disease, where first observed, subsides into a mere rigid inert mass.

Fig. 927.

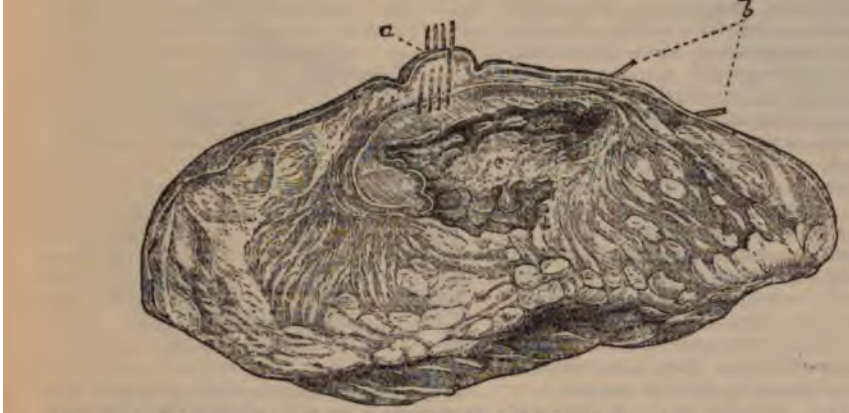


Progressive infiltration of the whole gland is represented in the woodcut, with the infiltration extending between the ducts, and by their side to the integuments. The nipple is not retracted, because infiltrated. From a drawing in the museum at Guy's Hospital, No. 413^{38}.

If the growth be of the tuberous variety, a circumscribed swelling is discovered in the breast, which at first increases slowly. But here there is always a visible sign of something new being superadded to the bulk of the gland, so that in proportion to the size of the growth the affected breast is just so much in excess of the dimensions of the sound one. This marked disproportion in the comparative sizes of the two glands, in relation to the quantity of new growth in the one diseased, is much more noticeable in tuberous cancer than in infiltrating. In the early stage, too, the pain in the part is more marked.

Occasionally, at the commencement of the disease, the truly infiltrating form may occur, and during its progress pass into the tuberous. But we do not meet with the opposite condition, at least as regards the gland-tissue. It frequently happens that, during the growth of a tumor or circumscribed mass of cancer, a cyst is formed upon its surface. At least a collection of serous fluid and blood, in relation with the growth, is frequently designated a cyst. In such a case the fluctuation of the fluid is usually distinct. Another change results from the centre of the new growth softening. Whether this process arises from inflammation or the immediate death of the tissues, we cannot here discuss; but the fact is important on account of the alteration it produces in the palpable signs of the tumor. After feeling solid, perhaps rather elastic, fluctuation is detected, and the surgeon hopes the case may prove to be one of chronic abscess. Even the visible signs which subsequently arise may favor the delusion; for the skin, becoming thin and red, *almost* assumes the ordinary appearance of the "pointing" of pus. The integuments ulcerate slowly. Several openings sometimes form consecutively. But the discharge is never genuine pus. It is curdy or flaky, blood-tinged, it emits a fetid, perhaps an offensive odor, and a healthy process is not excited. At last, the tumor being removed, a section through its centre shows the new growth, with a cavity in its interior; the walls of the hollow being formed of cancer-tissue, usually varying from a quarter of an inch to three-quarters in thickness. The fistulous openings in the skin lead to sinuses communicating with the interior of this growth.

Fig. 928.



The woodcut shows a section of a growth of this kind, which, softening down in the centre, leaves a hollow. The borders of the growth are seen, and pieces of glass (*b*) passed through the sinuses or fistulæ in the skin communicating with the cavity (*c*). (*a*) Nipple and ducts with bristles introduced. From a drawing in the museum at Guy's Hospital.

As a rare form of the disease, we must mention that one in which innumerable tubercles are disseminated throughout the substance of the gland; and which, by slowly growing, form larger and larger tubers, until they coalesce into a single mass.

Hitherto we have only described the development of cancer in relation to the breast. But in the progress of the disease all the surrounding structures become involved. Hence there are certain stages of this fearful malady which it is necessary absolutely to describe briefly before alluding to its treatment.

In both kinds of carcinoma, infiltrating and tuberous, the integuments become involved in the disease, but in very different conditions and degrees. In the former, the fat between the gland and the skin becomes absorbed, and the new growth extends along the fibrous septa, infiltrating those structures; and when it has reached the skin it spreads in that envelope far and wide. The adhesion between the skin and the anterior surface of the breast is very clearly indicated by dimpling or puckering of the integuments over the tumor, and the loss of the natural freedom of movement of the skin upon the gland. Very superficial ulceration next takes place in that part of the skin which has been for some time of a dull red or purplish tint. The ulceration extends deeper and deeper, wider and wider, sometimes leaving a large portion of the breast in a healthy state, whilst it creeps onwards in the surrounding integuments only. Occasionally with merely redness of the skin, sometimes even with scarcely a blush, and in rare cases with an absence of red altogether, the infiltration of the integuments advances, contraction of the infiltrated tissues takes place, and the whole surface of one side of the chest or of both sides is converted into a horny, rigid, unyielding envelope, which entails most acute suffering. Such is the cancer like a cuirass (*en cuirasse*) of the French writers.

In another case, after the skin has become once infiltrated, minute and isolated centres of cancer spring up in the neighboring integuments, and as they grow, the skin ulcerates, and several detached cutaneous ulcers are developed.

The tuberous variety increases with more or less rapidity, elevating the skin, which becomes thin, its vessels congested, and therefore of a brilliant hue, shining, and tense. This appearance sometimes closely resembles that of a pointing abscess; but it may be distinguished from it by its slow progress, the little pain accompanying the disease, a more sharply circumscribed redness, and the absence of that gently varying shade of tint from the centre to the periphery of the colored surface, so characteristic of inflammation. As regards, however, intensity of color, there is no disease which in this respect at all approaches the brilliant red of some varieties of tubers of carcinoma developed in the skin. The progress of this variety differs remarkably in different cases. The changes which occur are chiefly due either to morbid processes taking place in the new growth, and destroying it, or to the vitality of the growth being maintained when the disease progresses. Thus, two most opposite conditions result. In one, after the integuments have ulcerated, nearly the whole growth sloughs out; in the other, the tumor continues to grow, and a large fungating mass is formed, which reaches prodigious dimensions in some cases. Accompanying this fungous cancer there is generally a profuse serous secretion, sometimes almost clear, but emitting a sickening nauseating odor; at other times a sanious, purulent discharge, mixed with the débris of the growth, the effluvium from which is intolerably offensive. Profuse hemorrhages commonly take place from such growths, from which circumstance William Hey attempted to establish a special variety of cancer.

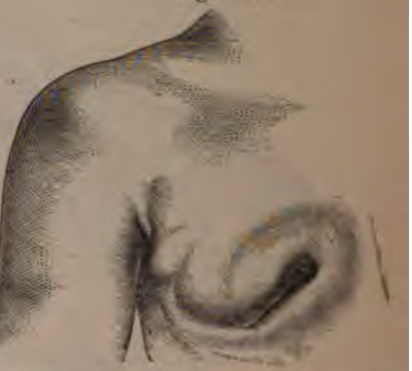
The above remarks apply to the most common varieties of cancer affecting the breast. Varieties both in appearance, mode of increase, rapidity and slowness of growth, from infiltration of neighboring tissues, and from accumulations of serum and blood enclosed in cysts, often occur; into a description of which the limits assigned to this essay do not permit us to enter.

Retraction of the nipple occurs in the infiltrating variety of carcinoma; it does not in the tuberous. It is always most marked when the infiltration is central; and sometimes the nipple may be drawn in and towards the hardness when lobular infiltration only exists. This state of the nipple then is pathognomonic only of the variety of the disease, and of the stage at which it has arrived. It should never be regarded as conclusive evidence of the nature of the disease, but merely as an accidental occurrence.

The nipple sometimes projects considerably after having been deeply retracted. That organ is then infiltrated with carcinoma. When thus diseased, the section, as represented in the woodcut [fig. 929], shows a remarkable prominence of the nipple.

The lymphatic glands in the axilla, above the clavicle, and even those at the side of the neck, become infiltrated with cancer as the disease advances. Usually, however, the growth in the breast has been observed some months before they are affected, and generally the integuments are more or less implicated before they are deeply involved. Sometimes the disease, first noticed in the breast, seems to remain quiescent, and the axillary growth advances rapidly. As the morbid condition of the axillary glands advances, the upper extremity becomes œdematous, serous effusion into the pleura of the same side takes place, and the sufferer dies without the primary local disease causing much trouble.

Fig. 929.



Infiltrating carcinoma of the breast and nipple. The figure shows a projecting nipple though apparently embedded in the adjacent tissues. Patient aged forty-five, growth, one year. Drawing in Guy's Hospital Museum, 409^{18}.

The causes of cancer, and hereditary influence, if there be any, relating to its generation, are points belonging to the natural history of the disease, which have been already described in the essay on CANCER.

The treatment of cancer of the breast may be carried out upon two principles. The surgeon has therefore to decide whether the growth shall be allowed to pursue its course under a palliative plan of treatment, or whether the tumor and diseased organ shall be taken off from the body by a cutting operation, or by some other method.

There are those who refuse to admit the efficacy of removing a growth of cancer under any circumstances, and there are others who would take it away in every case. A surgeon who would adopt either the one proceeding or the other exclusively must, we think, err in the treatment of this class of cases. The fact is, we believe, that, in a great number of persons, life may be prolonged, local suffering may be prevented, and much mental anxiety is sure to be avoided, by a careful and judicious selection of those cases in which the removal of the primary growth can be easily effected, and in which the constitutional powers of the patient render a surgical operation admissible.

We may here add, in a very few words, that in every case of the kind the state of the patient's general health is of primary importance. If that be impaired, the doubtful issue of an operation would deter most surgeons from recommending a proceeding under the influence of which the sufferer may sink; but when, as often happens, the constitution seems to be unaffected, surely that which the surgeon knows to be a sign, a source, an origin of impending misery, may be taken away with a fair hope of advantage. In order to point out the cases in which the removal of the cancer is neither desirable nor admissible, we may refer the reader to the lecture of Sir Benjamin Brodie,[1] and to the essay on CANCER.

We consider the operation of removing the tumor, together with the breast, always admissible when the health of the patient appears to be favorable to recovery from that operation, when the disease involves the tissues of the breast only, and when the axillary lymphatic glands are not involved.

We believe it may be undertaken with advantage when the disease has extended to the skin without infiltrating the cutaneous tissue to a wide extent, when ulceration has taken place, and even when the axillary lymphatic glands are distinctly perceptible and somewhat enlarged. As a general rule, it may be stated that the more limited the local disease is at the time of the operation, the better the chance of a satisfactory result as regards the region, and that if the general health of the patient be well attended to, after the wound has healed, some prospect appears of considerably ameliorating the condition of a sufferer affected by this disease.

We cannot here discuss the advantages or disadvantages of a cutting operation, as compared with the removal of the tumor by other methods. Both means have their advocates; both plans may be adopted in special cases. The one is expeditious, attended with little suffering, certain of removing the whole of the diseased organ. The treatment by caustics is tedious, attended generally with excruciating pain, and very uncertain in its operation.

In comparing the results of the two methods upon the constitutional progress or local relapse of the disease, there is not sufficient evidence in favor of one over the other. Both are commonly followed by a development of cancer either in the region first affected and its vicinity, or new centres of growth become established in distant parts.

The treatment of ulcerated cancer consists in following out the principles applicable to all sloughing open surfaces; thus, all those applications which tend to cleanse the surface are especially serviceable. Lotions composed of solutions of the chloride of zinc, permanganate of potash, terchloride of carbon, or chloride of potash, are very useful; with which sedatives, as morphia, solutions of opium, or belladonna, may be combined to soothe the pain. Some substances, applied in the form of powder, as equal parts of chloride of zinc and oxide of zinc, or the former mixed with some farinaceous powder or gum, serve very well to induce a more rapid sloughing of the new growth, and a more tolerable state of the ulcerated surface. By persisting in these applications, the wound occasionally even closes, and a tolerably healthy cicatrization of the normal tissues is the result.

The hemorrhages attending these ulcerated and sloughing surfaces may be controlled by cold, by the application of astringent powders or lotions, and other common styptics. When practicable, the slough from under which the bleeding usually takes place should be removed, in order that the styptic may reach the open vessel.

The œdematous condition of the tissues of the upper extremity which in some cases ensues upon infiltration of the axillary lymphatic glands, is a source of great suffering, which it is very difficult to ameliorate. Local means generally avail little. The elevation of the arm assists the return of the serum, and subcutaneous punctures are beneficial.

When a second, a third, or even a fourth or more growths appear, their removal is quite justifiable, provided the constitutional powers of the patient be good, and the local disorder threatens to become a source of prolonged misery and suffering.

The mortality depending upon causes referable to the operation of amputation of the breast is extremely small; the proportion in cases treated in Guy's Hospital being about six per cent.; whilst in private practice it has not amounted to anything like that figure.

The limits of this essay preclude even touching upon the many points of great interest in the natural history of cancer; but the reader may supply the deficiency by turning to that on CANCER, in which the whole subject of the disease is fully treated of. But I cannot conclude without urging the expediency of removing the *first* growth of cancer in *select* cases. I do so upon the firm conviction, based upon experience, that by so acting life may be prolonged; a certain amount of immunity from bodily suffering and mental distress may be ensured; the chance of freedom from all local suffering is given; and that, when unhappily the recurrence of the disease gives rise to ulceration, the duration of that distressing state is shortened.

[Mr. Birkett's classification of tumors

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[1] Lectures on various subjects in Pathology and Surgery.

differs so much from that of many recent authors, that it seems necessary to say a few words regarding the theories more prevalent at the present time. The popular, but by no means thoroughly established doctrine of the Germans, that the three layers of the blastoderm preserve through life their individuality and independence, each giving rise to its own peculiar kind of tissue, has led to the adoption of a classification of tumors founded upon their anatomical and genetic peculiarities. Advocates of this doctrine divide neoplasms into two great classes: 1st, the epidermal and epithelial growths, which are supposed to spring invariably from the outer and inner blastodermic layers; and 2d, the neuromata, angiomata, myomata, lymphadenomata, and tumors of connective tissues, all of which arise from the meso-blast. In placing a tumor, therefore, they seek, 1st, to determine its tissue origin, and 2d, its anatomical characters, the latter determining the sub-class to which it shall be assigned. Without entering further upon a subject which has doubtless been discussed in the chapter on the general subject of tumors, it is sufficient to say that Mr. Birkett's fibro-plastic tumors, and many of his tuberous and cystic cancers, are described in other authors as atypical tumors of connective-tissue type, under the name of sarcoma. Certain tuberous and cystic cancers still hold their place as true cancer, arising from an epithelial matrix. The infiltrating variety, or scirrhus, regarded by most authors as a true epithelial cancer, is assigned by Cornil and Ranvier a place among the tumors of connective-tissue origin.

As regards the diagnosis and treatment of tumors, the systematic authors fail apparently to comprehend the necessities of the general practitioner. In the early stages of a neoplasm's growth, when the family physician is called upon for advice and treatment. the difficulties of diagnosis are different and vastly greater than at a later period, when it comes before the consulting surgeon. The determining symptoms, which afterwards make the character of the swelling unmistakable, are then absent. An ill-defined tumefaction, a scarcely perceptible hardening of the tissues, may be the sole indication of what may soon grow into a large tumor. The rules for diagnosis, laid down at great length in the books, and depending upon the mode of growth and development of the tumor for their value, do not meet the needs of that stage when the tumor has hardly begun to grow, nor to show its peculiar tendencies. The inexperienced practitioner finds himself thrown then upon his own resources in a matter of great concern. It would seem necessary to supply this gap in our literature, if in no other way, by at least stating definitely the limits of our art. The general practitioner is not so much concerned about the refinements of diagnosis as about those major questions which bear directly upon treatment. It is to the patient immaterial whether a certain growth be called sarcoma or cancer, but it is of vital importance to determine whether its tendencies are or are not malignant. If this cannot be determined, it then becomes important that the physician should pursue the right course until the doubt shall have been solved. It is singular that the most common and serious difficulties are often lost sight of while lesser problems are treated at great length. Gross, in his recent work on Mammary Tumors, devotes a chapter to diagnosis, and discourses at length upon the differences between benign and malignant tumors, a matter of comparatively little importance as regards treatment. A neoplasm should be cut out, whether benign or malignant, and the only difference in the treatment would be in the greater or less promptitude in operating, and in the amount of tissue removed. He says almost nothing, on the other hand, about the far greater and more perplexing problem of diagnosticating tumors in their early stages from inflammatory conditions and indurations. In fact, by far the greater number of errors committed in the diagnosis of mammary tumors, are made in confusing the phenomena of inflammation, acute or chronic, and those of the growth of tumors. I have seen malignant sarcomata mistaken, again and again, for acute and subacute inflammation, but only once in a mammary tumor. In February, 1874, an intelligent physician brought his wife to me for advice. Her last child was born on June 23, 1873. She had nursed it from both breasts. In September the right breast became sore and swollen. It seemed inflamed, and was treated accordingly. After several weeks the swelling partially subsided, the pain grew less, and fluctuation was felt deep in the breast. It was lanced, and a quantity of straw-colored fluid evacuated. It was after this that the husband began to suspect that the continued swelling meant something more than an abscess. When I saw it, the breast was occupied by a large, soft tumor, which extended up under the great pectoral muscle. The lymphatic glands were not then involved. Extirpation on March 3d was followed by recurrence in the supra-clavicular glands, and a speedy death. The tumor was a round-celled sarcoma.

A case was once related to me which had a similar history of acute inflammation marking the growth of malignant disease. A young girl received a blow on the breast; a severe inflammation followed. In the inflammatory tissue a tumor developed, which soon destroyed her.

I have seen several cases with similar history but of other organs, and especially the eye, upper jaw, and axillary space, and I will frankly confess that I do not know of any means of diagnosis excepting to await the development of the disease by time; the apparent inflammation accounts for all the phenomena. An exploring needle, if introduced, would secure only blood or at most a few cells not to be distinguished from pus cells. It must be remarked also that the preconception in the mind of the attending physician delays the recognition of such cases, long after their character has become patent to an unprejudiced observer.

There are but two pathological conditions which are frequently mistaken for hard cancer of the breast; the one are the little cysts, so common in middle-aged and old women. These grow sometimes quite rapidly, become tensely filled with fluid, and feel quite hard under the overlying tissues. They are often associated with cancer. The exploring needle will readily detect their nature, and they need never be mistaken except when surrounded with a very thick wall. The other are the chronic indurations which are quite common in the breast either as a hard, circumscribed lump, or as a general interstitial chronic mastitis. The common error of the inexperienced practitioner is to mistake the beginning of scirrhus for this more benign trouble. Either the lump in the gland has a history of injury or there has been a previous mastitis, or the physician is reluctant to suspect evil of a small knot, deep in the tissue, without adhesions or accompanying lymphatic involvement. The diagnosis of scirrhus from inflammatory trouble becomes easy enough in time, but is exceedingly difficult if the surgeon, wishing to operate at the period of its earliest infancy, refuses to await the evidences of infection. Occasionally it is the other way, and indurations are mistaken for scirrhus. I was once consulted by a woman of forty, who a month previous had discovered a painless lump in the lower margin of the right breast. It was very hard, and attached to the adjacent tissue. I urged an operation. She lived in Buffalo, and went home to consult an eminent surgeon of that city. He coincided in my opinion, and she began to prepare for an operation, when suddenly the knot became dissolved in pus. In diagnosticating inflammatory conditions from malignant growths, the student may remember that while acute and subacute inflammations of the breast are quite common, encephaloid tumors simulating them are quite rare, and on the other hand that in nine cases out of ten, hard lumps accruing in the breasts of women of thirty-five and over will prove to be scirrhus, and only in the tenth case an inflammatory induration.

In considering the treatment of tumefactions of the mammary glands, the surgeon must bear in mind that the very worst physical evil which can befall a human being is to become infected with malignant disease. He who believes in the local origin of all tumors will not hesitate long in concluding to operate when possible, upon all such cases, before evidences of infection have become manifest. To do this, is to operate before the clinical proofs of cancer have become positive, at a time when it may be yet doubtful whether the surgeon have before him a benign induration or malignant tumor. The rule should be held imperative that all cases which, after a short trial of remedies, still remain doubtful, should be subjected to the knife. The dangers of an operation do not for a moment compare with those of malignant infection.]

SPECIAL DISEASES. DIVISION IV.

DISEASES OF THE NIPPLE AND AREOLA; THE SINUSES; THE SEBACEOUS GLANDS.

Deficiency of the nipple.—This deformity results from an arrest of its development, or is produced by disease. When, however, a breast exists, there is always a trace of a nipple and areola. There may not be the slightest elevation; even a depression may occupy the site of the mammilla; but the milk-tubes terminate between the rugæ on a small spot of skin. The nipple is often destroyed by disease. Thus gangrene occasionally attacks it, and the whole organ falls off. Also, a nipple once well formed may be drawn inward or retracted, and so deeply that its extremity is entirely lost to view. But in every case in which a surgeon observes this condition, especially if associated with disease, he should be scrupulously careful to ascertain if the deformed organ was ever perfectly developed.

A bifid nipple is sometimes seen; and occasionally it is ill-shaped, being clavate, pendulous, and covered with small tubercles. Hypertrophy of its tissues occurs but rarely. There are cases on record in which several nipples have been developed on one breast (*pleiomastia*).

Inflammation often attacks the nipple. It is especially prone to this condition during the first occasion of suckling, and with some women at the commencement of every lactation. The most frequent result of that morbid condition is the production of superficial ulceration upon its surface. Small ulcers are formed between the rugæ, on its apex and sides, and sometimes they encircle its base, even extending upon the areola. The abraded surfaces are exquisitely painful, and they often bleed freely. Much constitutional disturbance, mental distress, and acute local suffering are excited by these superficial ulcers, which are commonly termed "cracks," "fissures," or "chaps." It is asserted that these ulcers are frequently engendered by the morbid state of the mucous membrane of the infant's mouth. We have not, however, been able to obtain sufficient evidence of the validity of the statement. As regards treatment, the most essential point towards remedying these troubles consists in frequent ablutions with warm water, in abstaining from the application of irritating lotions and ointments, but protecting the part with moist cotton-wool and gutta-percha tissue. A difficulty in most cases arises from the necessity of suckling the infant. Various "shields" are constructed, therefore, to protect the organ from the pressure and dragging caused by the lips and tongue of the infant. The application of soothing substances is preferable to those which produce pain, and, therefore, a little glycerine, collodion, or almond-oil is beneficial. Astringent, stimulating, and narcotic applications are not always admissible, on account of the suffering they entail upon the mother, and the risk of injuring the infant. Substances in dry impalpable powder are beneficial. Thus, the oxide of zinc, carbonate of magnesia, lycopodium, prepared chalk, may be tied up in very fine muslin, and the nipple dusted with the particles which pass between the threads. Abscesses, sloughing, herpetic or eczematous eruptions affecting the nipple, require no special mode of treatment.

Hyperæsthesia of the nipple.—We have seen a curious condition of the nipple, but only once, to which the term hyperæsthesia seems the most applicable. The organ became, upon exposure, rigid, its follicles very distinct, its base red, and its point bloodless and hence quite white. It was on the person of a middle-aged, married, but sterile woman, who described the pain as most acute.

Inflammation and abscesses, together with various cutaneous eruptions, are developed in the tissues of the areola. Abscess often forms in the portion of the gland immediately beneath it. The point of chief importance to remember, in connection therewith, is that the lacteal sinuses are placed here, and that great care is requisite to avoid cutting them transversely if a bistoury is required to be used. It is always desirable to allow pus to point very prominently when it is formed beneath the areola; and if an incision be made, the direction should always pursue a straight line radiating from the nipple. The effect of departure from these directions may be the division of a duct; the consequence of which will be that, a fistulous opening being established, the milk will flow freely every time the woman suckles, for it rarely heals until after weaning.

Within the area of the nipple and areola new growths are occasionally developed. Pendulous, cutaneous formations; follicular tumors, or cysts, containing sebaceous secretion; vascular growths of true erectile tissue; epithelioma and infiltrating carcinoma, have all been met with in various degrees of frequency; but as they require to be treated upon the same principles as when found in other parts, it would be idle to dwell upon them here.

SPECIAL DISEASES. DIVISION V.

DISEASES OF THE MALE MAMMILLA.

The affections of the male organ relate to its conditions in a perfectly rudimentary state, and when there is a gland developed; for we have seen and dissected as perfect a passive glandular structure taken from a man as was ever formed in a young girl. Soon after birth the organ becomes tumid, and a secretion forms within the ducts. If left to nature, no difficulty arises. Should inflammation happen, which usually arises from the officiousness of nurses, it must be treated as before described.

At puberty the gland usually enlarges, becomes painful for a few days, and then slowly decreases until nothing but the nipple is perceptible. But if the part be irritated, inflammation running on to the formation of abscess will be excited. In rather delicate men the gland is sometimes largely developed,—hypertrophy. This may occur on one side only, or on both sides. The circumstance generally excites annoyance, but no ill result; although the curious may see in pathological museums breasts of this kind which have been removed and labelled "scirrhus." When these breasts are painful, the improvement of the general health is indicated, and all local pressure must be avoided.

The male is subject to deformities arising from excess of mammillæ; thus we have seen a man with four nipples. We have met with a man who had one only, on the right side. The defect was associated with absence of the lowermost fibres of the left pectoral muscle.

The diseases of this organ in the male are of the same kind as those in the female, already described. But disease very rarely attacks this part in a man. We have seen a sebaceous cyst developed close to the nipple and elevating it, and so closely resembling the bluish-red tint of a tuber of cancer just about to ulcerate as to excite grave apprehensions; but it was excised with the happiest result. Not long since, Mr. Prescott Hewett[1] removed a cyst and intra-cystic growth from a man's breast.

Carcinoma is the new growth most commonly developed in the male breast. It occurs generally between forty and fifty years of age, either in the infiltrating or tuberous form; generally, however, in the former, extending slowly, and affecting the integuments in its progress. Its treatment is similar to that adopted in the case of a like disease in the female.

[DISEASES OF THE SKIN.[2]

By Arthur Van Harlingen, M.D.

In order to gain a satisfactory conception of the nature of any given skin-disease, in itself considered, some preliminary knowledge of the structure and functions of the normal skin is necessary, and also a clear idea of the character and appearance of the individual lesions which go to make up the objective picture known as the eruption. To understand the various diseases of the skin in their relation to each other, they must be arranged in some sort of classification.

With regard to the first of these desiderata, the anatomy and physiology of the normal skin, the reader is referred to the various text books upon skin-diseases, particularly that of Duhring,[3] where these subjects are clearly set forth and illustrated. With respect to the various lesions of the skin and the classification of the different affections, these may be succinctly described here before entering into their consideration individually.

Primary lesions of the skin.—These are such as show themselves as primary forms of disease. They are: *maculæ* (macules); *papulæ* (papules); *vesiculæ* (vesicles); *bullæ* (blebs); *pustulæ* (pustules); *pomphi* (wheals); *tuberculæ* (tubercles); and *tumores* (tumors).

Maculæ are variously sized, shaped, and colored portions of altered skin, unaccompanied by elevation or depression. *Papules* are circumscribed, solid elevations of the skin, varying in size from a pin-head to a split pea. *Vesicles* are circumscribed rounded elevations of the epidermis, varying in size from a pin-point to a split pea, containing a clear serous fluid. *Blebs* are irregularly shaped elevations of the epidermis, varying in size from a split-pea to a goose-egg, containing a clear or opaque fluid. *Pustules* are circumscribed, rounded elevations of the epidermis, varying in size from a pin-point to a finger nail, containing pus. *Wheals* are firm, flat, elongated, or rounded, slightly raised elevations of an evanescent character. *Tubercles* are firmly seated solid elevations of the skin, varying in size from a split pea to a cherry. *Tumors of the skin* are variously sized, shaped, and constitute firm prominences.

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[1] Lancet, vol. i., 1864.

[[2] It was at first intended that the article on Diseases of the Skin, in the latest English edition of this work, should be reproduced here with such notes and additions as might seem desirable to bring the text up to the level of our present knowledge. The progress of this branch of medicine has, however, been so great during the past ten years as practically to revolutionize the entire subject, and it has been decided, after some consideration, that the purpose in view would be better gained by a completely new article written from the standpoint of the dermatology of to-day. In preparing this article, therefore, I have only made use of the English authors' work incidentally, quoting them as in the case of the other authorities.

[3] A Treatise on Diseases of the Skin, by Lewis A. Duhring, M.D., 2d ed., Phila., 1881. Also, by the same author, Atlas of Skin Diseases, in nine parts, Phila., 1876–81. These will hereafter be referred to in an abbreviated form. Duhring's work, the most complete in the English language, has been used largely in the preparation of this article, and the definitions of the several diseases have in each case been taken entirely from it. For further information regarding the rarer affections omitted here or only touched upon, the reader is referred to the work itself.

Secondary lesions of the skin.—Such lesions of the skin as exist either as the result of primary lesions or from other causes. They are: *crustæ* (crusts); *squamæ* (scales); *excoriationes* (excoriations); *rhagades* (fissures); *ulcera* (ulcers); and *cicatrices* (scars).

Crusts are effete masses of dried material composed of the products of disease of the skin. *Scales* are dry laminated masses of epidermis which have separated from the tissues beneath. *Excoriations* are losses of tissue occurring in the superficial layers of the skin. *Fissures* are linear wounds having their seat in the epidermis or corium. *Ulcers of the skin* are irregularly sized and shaped excavations of the cutaneous tissues, the result of disease. *Scars* are new formations occupying the place of former normal tissue.

Classification of diseases of the skin.—No classification of the skin-diseases has yet been devised which has gained universal acceptance. That of Hebra, however, has of late years come more and more into use, and is perhaps more generally employed at present than any other. The American Dermatological Association has adopted Hebra's classification with some modifications, and has given the weight of its authority, that of the leading dermatologists of this country, to this plan. For that reason, and because the classification is one which is intelligible and practicable, it has been adopted in this article. It includes the following nine classes:—

I. DISORDERS OF THE GLANDS; (1) of the sweat glands; (2) of the sebaceous glands.
II. INFLAMMATIONS.
III. HEMORRHAGES.
IV. HYPERTROPHIES; (1) of pigment; (2) of epidermal and papillary layer; (3) of corium.
V. ATROPHIES; (1) of pigment; (2) of hair; (3) of nail; (4) of corium.
VI. NEW GROWTHS; (1) of connective-tissue; (2) of vessels; (3) of granulation-tissue.
VII. ULCERS.[1]
VIII. NEUROSES.
IX. PARASITIC AFFECTIONS; (1) vegetable; (2) animal.

CLASS I.—DISORDERS OF THE GLANDS.

(1) OF THE SWEAT-GLANDS.

HYPERIDROSIS.

Hyperidrosis is a functional disorder of the sweat-glands, consisting in an increased flow of sweat. The affection may be very slight, merely manifesting itself in a dampness of the skin, as in those persons who suffer from "clamminess" of the hands or feet; or it may show itself in the pouring forth of very large amounts. It may be acute or chronic, and it may be localized at certain points, as the palms and soles, which are the ordinary seat of the disease, or it may involve the whole body, as in pneumonia, tuberculosis, rheumatism, etc. Local hyperidrosis is often a disagreeable and stubborn disease. It usually occurs on the palms, soles, axillæ, and genitalia,—on one or both sides. Cases of unilateral sweating are occasionally recorded, when the disease may affect one entire half of the body. The quantity of perspiration secreted when the disease occurs on the palms or soles is occasionally excessive; when affecting the former, the sweat may at times drip from the ends of the fingers when the hand is held down, as if it had just been dipped in water. The amount of sweat secreted at one time or another depends on various circumstances, as the condition of the patient, exercise, temperature, etc.

The skin cannot be kept dry, and it usually presents a whitish or yellowish color and a soggy, water-logged appearance. When the soles are affected, the socks and shoes become moist, and the latter especially becoming soaked with decomposing secretion, are apt to smell very badly and to render the patient annoying to himself and disgusting to others. Sometimes the epidermis of the sole peels off and walking becomes difficult. The disease may last for years; when it occurs about the genitalia, erythema and intertrigo frequently accompany it.

The causes of hyperidrosis are often difficult or impossible to determine. In many cases it appears to be the result of some disturbance of the nervous system, debility, or faulty innervation. It occurs at all ages and in both sexes: in the cleanly and among the dirty alike. It is apt to be worse in summer.

The treatment of hyperidrosis should be both general and local. If there be debility, tonics are called for. Iron, quinine, strychnia, and the mineral acids are to be employed. Belladonna, ergot, and faradization have been employed with success. The cause should be ascertained if possible and vigorously combated. Every hygienic means, as diet, regimen, cold bathing particularly, should be brought into play. Local treatment is particularly useful. Patients are apt to use too much water, in washing the parts too frequently. The parts should be wiped with a damp cloth from time to time, and immediately dried with a soft towel without friction. Various dusting powders, as starch, lycopodium, magnesia, and oxide of zinc, or the same with the addition of half a drachm of salicylic acid to the ounce may be used. They should be removed and renewed as soon as they become moist and caked. They are ordinarily only serviceable in milder cases. Lotions containing alcohol alone, or with the addition of some astringent, will be found useful. The following is a convenient formula:—

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[1] Ulcers, having been treated of elsewhere in this work, will not be described in the present paper.

℞. Acidi tannici, ʒj.
Alcoholis, ℥viij. M.
Sig. Use as a lotion.

Salt baths are sometimes found serviceable. Tincture of belladonna, diluted or in full strength, may be employed; its constitutional effects being guarded against. Weak solutions of chloral, permanganate of potassium, and salicylic acid have been employed with success. In hyperidrosis of the palms and soles, Mr. Wilson suggests washing with carbolic-acid or juniper-tar soap, followed by the application of the following ointment spread upon cloths and secured in place with a bandage.

℞. Ung. picis liq.,
Ung. sulphuris, āā ℥j. M.

For obstinate cases, involving more particularly the soles, and when the patient is able to give up his occupation for the time being, the treatment recommended by Hebra is the most satisfactory. In order to be successful, its various steps must be carried out with care and fidelity. The parts are to be cleansed with water and soap, and the following ointment applied:—

℞. Emplast. diachyli, ℥iv.
Olei olivæ, f℥iv. M.

The plaster is to be melted and the oil added and stirred until a homogeneous mass results.

Pieces of muslin or cotton-cloth are to be cut to the size of the parts, and the ointment spread on thickly and applied. Lint smeared with the ointment is also to be placed between the toes or fingers, so that every portion of the skin may be completely covered with a layer of the ointment. The dressings are to be bound down closely by means of a bandage. The clothes are to be changed twice in the twenty-four hours, when the parts are *not* to be washed, but simply rubbed dry with lint and a starch dusting-powder, after which new dressings are to be applied in exactly the same manner. This treatment is to be continued from one to several weeks, according to the severity of the case. Even when the disease is on the soles, the patient may be permitted to walk about in loose shoes. At the expiration of eight or ten days, the parts are to be rubbed with the dusting-powder and the dressings discontinued. The powder should be used for several weeks longer. Usually the sweating tends to lessen and gradually disappear after two or three weeks from the beginning of the treatment. A repetition of the course in severe cases is sometimes necessary before bringing about a complete cure. Slight cases of hyperidrosis may often be cured by the use of juniper-tar, carbolic-acid, or sulphur soaps.

The prognosis depends somewhat upon the state of the patient's health, the duration and locality of the disease and its extent. Many cases are easily cured, while others are extremely intractable. The ability of the patient to follow the treatment must also be considered, as careful attention to the directions given is almost essential to a cure.

Anidrosis is a functional disorder of the sweat-glands consisting in a diminished and insufficient secretion of sweat. It occurs in connection with certain chronic diseases of the skin, as ichthyosis. In some cases an individual ceases at times to sweat. In these cases the health is more or less impaired, and serious symptoms may arise, especially during warm weather. In the treatment every effort should be instituted to promote the activity of the skin. Hot or cold baths, steam-baths, and frictions may be employed. It would seem that in cases like these, the administration of pilocarpine might prove useful. I do not know, however, of any case in which this has been tried. Of course all such hygienic measures as tend to promote the general health should be brought into play.

Bromidrosis is a functional disorder of the sweat-glands, characterized by more or less sweating and an offensive odor. The affection may be local (it usually occurs on the soles) or general. The odor may be of a general disagreeable character or it may be distinctive, resembling that of a goat or of urine. Hammond[1] relates several cases of odorous sweat, the smell resembling that of violets or pine-apple, and occurring during attacks of hysteria, anger, or sexual excitement. The treatment is that of hyperidrosis. One of Hammond's cases was cured by the administration of salicylate of sodium in five-grain doses.

Chromidrosis shows itself in the excessive secretion of variously-colored sweat, which may be bluish, blackish, reddish, greenish, or yellowish. It is apt to be intermittent.

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[1] The odor of the human body as developed by certain affections of the nervous system; New York Med. Record, vol. xii., 1877, p. 460.

Uridrosis is the name given to an excretion from the sweat-glands containing the elements of the urine, especially urea. It shows itself generally in the formation upon the skin, usually of the face and hands, of a colorless or whitish, saline, crystalline deposit or coating, which in some cases is said to have had the appearance as though flour had been sprinkled over the surface. The deposit can be scraped off with a knife, and is seen under the microscope to present small crystalline spiculæ. In most of the cases reported, partial or complete suppression of the renal function, with disease of the kidneys and uræmic poisoning, were present.

Phosphorescent sweat is sometimes observed. Carpenter[1] reports a case from Koster, where the body-linen was rendered luminous by the perspiration after any violent exercise.

SUDAMINA,

(called by Hebra, *miliaria crystallina*) is a non-inflammatory disorder of the sweat-glands characterized by pin-point or pin-head sized, translucent, whitish vesicles. These are discrete, but are usually crowded together in great numbers. They occur mostly on the neck, chest, abdomen, and other regions of the trunk. They are slightly elevated, and resemble minute drops of free sweat. They form quickly, their contents do not become puriform; nor do they rupture. They simply dry up, and their desiccated covering membrane forms a slight desquamation. The disorder occurs in some fevers, and also among children, and in delicate persons during hot weather. Its presence is to be considered as a sign of debility. The treatment, of course, is to be directed against the cause. In addition, a slight astringent powder, as starch or the oxide of zinc, may be employed for the patient's relief.

(2) OF THE SEBACEOUS GLANDS.

SEBORRHŒA.

Seborrhœa is a disease of the sebaceous glands of the skin, consisting essentially in an increase of the quantity of secretion poured out, and usually also in a change in the quality of this secretion. In the new-born infant seborrhœa is to a certain extent physiological; it may form a fatty layer over the entire surface, a remnant or modification of which is seen in the caked incrustation that is subsequently observed on the scalp. There are two varieties of seborrhœa—S. oleosa and S. sicca.

Seborrhœa oleosa appears in the form of an oily coating upon the skin, giving it an unctuous and greasy feel. Its most common seat is the region of the face, and more particularly the nose and forehead, where it appears as a greasy layer containing more or less dust and dirt, and looking as though the skin had been smeared with a dirty ointment. It is sometimes observed on the scalp, when it collects in the hair, giving it a dark limp look, as if freely oiled. In bald persons it sometimes occurs in the scalp, making it look as if freshly oiled.

Seborrhœa sicca, which is by far the commoner form of the disease, manifests itself both upon the hairy and non-hairy regions. It shows itself in the form of dry masses of scales of a dirty white or yellowish color, which ordinarily tend to adhere to the skin. On the scalp these scales are sometimes of a rather dry, branny character, which are constantly shed and fall upon the patient's clothing, forming the well-known "dandruff." At other times they are larger and oilier, tending to cling to the skin in masses, and leaving when picked off a smooth, grayish, moist, or oily surface beneath. After a while the hair becomes affected and commences to fall out, the process eventually terminating in permanent baldness of greater or less extent. Seborrhœa is one of the commonest causes of premature loss of hair.

On the face, seborrhœa sicca is rather unusual, the disease here more commonly taking the oily form. When it does occur, it is in the form of oily crusts, occurring about the cheeks, nose, and forehead, having deep prolongations or plugs running down into the sebaceous glands, and when removed showing a general hyperæmic condition of the surface beneath. These crusts are usually of a bright yellow, but may be grayish, greenish, or even blackish. Particles of extraneous matter floating in the air at times collect on the surface, and add to the disfigurement caused by the disease. The crusts re-form rapidly when cleaned off. Itching and burning sensations usually, but not invariably, accompany the disease in this locality. When seborrhœa occurs upon the nose, this organ is usually of a dusky-red and shiny. Though looking as if the seat of inflammation, it is in reality unnaturally cold; the openings of the glands are enlarged and patulous. Seborrhœa of the nose, and less frequently of the face, is one of the sequelæ of variola. Seborrhœa frequently attacks the genitalia in both sexes, the sebaceous glands in these parts being numerous. In the male the glans penis and sulcus are most usually affected. When the foreskin is long and not often retracted balanitis may result, the secretion when not removed rapidly decomposing and becoming acid and irritating. In the female the same product is found about the labia and clitoris. On the body seborrhœa presents a peculiar aspect. It usually occurs between the scapulæ or over the sternum, not often showing itself in other localities; it appears in the form of finger-nail to palm-sized, irregularly-grouped patches, of a reddish-yellow or dirty-yellow aspect, covered with loose scales, or, when these have been rubbed off, showing the gaping mouths of the sebaceous follicles. Acne papules and pustules are seen here and there about these patches, indicating the involvement of the sebaceous glands. On the back, these patches resemble tinea versicolor, but on the chest they often assume a circinate appearance like ring-worm. Seborrhœa of the body frequently itches, but ordinarily is without sensation. It is apt to disappear in summer.

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[1] La France Med., March 31, 1877. Cincinnati Lancet and Observer, May, 1877, p. 504.

Seborrhœa is induced by various causes, prominent among which is the chlorotic or anæmic state. Persons who suffer from seborrhœa are, as a rule, pale, thin, and poorly nourished. The various functions of the body are apt to be deranged. It is more apt to occur about puberty or in early adult age. It may occur in healthy persons, and is usually in such cases easily curable by local measures.

Seborrhœa is altogether a functional disorder of the sebaceous glands, no change ordinarily taking place in their structure. It consists essentially in the excessive secretion of more or less altered sebum, mingled with a greater or less proportion of epithelial scales. If the process be allowed to run on indefinitely, however, atrophy of the glands, follicles, and adjacent structures may occur, especially upon the scalp.

The diagnosis of seborrhœa is ordinarily not a matter of much difficulty; the evident sebaceous origin of the disease marking its nature sufficiently. Occasionally, however, owing to its varied aspect, as the oily or epithelial character of the diseased product predominates, or as the affection occurs in one part of the body or another, it is apt to be confounded with several affections more or less closely resembling it. Upon the scalp the dry form is apt to be mistaken for dry eczema, but the latter usually gives a history of moisture at some period, and the scales are drier and scantier. Eczema is likely to occur in patches instead of being diffused, whereas seborrhœa is more uniformly distributed. Eczema itches more severely than seborrhœa. The skin is reddish and infiltrated in eczema, while in seborrhœa of the scalp it is paler. About the face seborrhœa sometimes resembles eczema, but the involvement of the sebaceous glands is usually obvious. Seborrhœa, both on the scalp and on the body, often resembles psoriasis. On the scalp, however, psoriasis is more apt to occur in patches with good skin between. In psoriasis the scalp beneath the scales is always reddish and inflamed, the affection is likely to crop down beyond the edge of the hair, and characteristic psoriasis patches are often found on the knees and elbows. Moreover, the histories of the two diseases are very different. On the body, patches of seborrhœa often look extremely like ring-worm. Their history, the slowness with which they have developed, and their greasy appearance, will usually decide the question, while in doubtful cases the presence or absence of fungus (see tinea circinata) will settle definitely the nature of the affection. From lupus erythematosus, which seborrhœa often closely resembles, especially upon the face, and of which in fact the latter is often the precursor, the diagnosis is sometimes difficult. When fully developed, however, lupus presents very decided differences of appearance. It presents a sharply-defined border, often slightly raised; there is more hyperæmia, infiltration, and thickening. The patches of seborrhœa are pale or reddish, those of lupus are dark red, at times almost the color of raw beef; they are covered with flat tenacious scales, are evidently the result of new cell-growth, and are followed by cicatrices. Seborrhœa never eventuates in a cicatrix.

The treatment of seborrhœa should usually be both local and constitutional. Fresh air and exercise, especially in the case of young women, is to be insisted upon. A carefully regulated diet should be prescribed, with a view to excluding indigestible or highly seasoned food, and also the avoidance of such articles as are found by experience to disagree with the patient. In seborrhœa, as in some other skin-diseases of an inflammatory nature, diet and regimen are of the highest importance. The history of the patient and the course of the disease should be carefully looked into, and any functional irregularities corrected when possible. The causes upon which the disease depends in any given case are to be carefully sought out, and these are sometimes obscure. Success in treatment often depends upon ascertaining and meeting the exciting cause of the seborrhœa in the individual. When the patient betrays a consumptive or strumous taint, cod-liver oil, or, in some cases, ground flaxseed in tablespoonful doses, mixed in a tumblerful of warm milk, and taken at meal-times, should be prescribed. Iron is very valuable, a
will be found indicated in a large nu

of cases. The following is an agreeable form for the administration of the tincture of the chloride :—

℞. Tinct. ferri chloridi, f℥j.
Acidi phosphorici dil., f℥j.
Syrupi limonis, f℥ij. M.
Sig. Half a teaspoonful three times a day with a wineglassful of water. To be taken through a glass tube.

Arsenic is often of great use, but it should be remembered in the employment of this drug in other skin-diseases as well as in seborrhœa that it must be given in somewhat smaller doses than those usually recommended, and that its use must be continued through a considerable period in order to obtain the best results. With many persons arsenic does not agree well at first, and it should always be given cautiously in the first instance. Should moderate doses disagree the drug may be given in minute doses, a single minim or less, of Fowler's solution—increasing the amount as toleration is established. I have thus been able to give as high a dose as ten minims in the case of a patient who could at first tolerate only half-minim doses. Arsenic may advantageously be combined with iron as follows :—

℞. Liquor potassii arsenitis, fʒij.
Vini ferri, f℥iv. M.
Sig. A teaspoonful thrice daily, after eating, in a little water.

The dose of Fowler's solution here indicated is four minims, which is a fair average amount. The patient should take a half teaspoonful at first and increase the quantity at each taking until the full teaspoonful is reached if the medicine be found to agree. A little griping pain in the stomach or a little itchiness of the eyelids with slight lachrymation are the only signs of want of toleration to be expected, and it is never necessary to push the drug to this extent in the treatment of seborrhœa.

The local treatment of seborrhœa is very important. It should differ somewhat according to the region involved. In seborrhœa of the head, if there be an accumulation of scales, these are first to be removed in order that the applications may reach the diseased skin. Hot water and white castile soap made into a lather and used as a shampoo will ordinarily suffice for the purpose of removing the scales, but when these are very abundant and tenacious further means must be employed. The scalp may be thoroughly rubbed with one of the bland oils, as olive or almond oil, which should be used in abundance and allowed to macerate the inspissated sebum and scales; the operation should be performed in the evening, the patient's scalp being covered with a night cap and bandage to keep the oil from soaking through. In the morning the cap is to be removed and the scalp thoroughly cleansed with the following soapy wash, which will be found more efficient than a hard soap.

℞. Saponis viridis (Hebra), ℥viij.
Alcoholis, f℥iv. M.
Solve et filtra. Sig. To be used as a wash or shampoo.

This wash is the "spiritus saponis kalinus" of Hebra, and is a most efficient detergent. A tablespoonful may be applied to the scalp with a sponge, and a considerable quantity of warm water added so as to make a lather. After vigorously shampooing the scalp for a few minutes the soapy matters are to be washed away with an abundance of clear warm water, the scalp dried quickly with a soft towel, and it is then ready for the local application of remedies. These should be in the form of oils. Ointments should rarely be used in the scalp unless the hair is very thin or absent, as they mat the hair and make it sticky and greasy without penetrating to the spot where they are most needed, namely the skin itself. The kind of oil to be used will depend upon the condition of the scalp. If irritated, one of the simple oils or benzoated vaseline, which is not open to the objection made against other ointments, may be used. Glycerine and water, or glycerine and alcohol in the proportion of one part of the former to two or four of either of the latter, constitute excellent mild applications. Generally, however, the scalp will bear more stimulating applications. Of these carbolic acid is one of the most efficient, as in the following combination :—

℞. Acidi carbolici, ℈j.
Ol. ricini, fʒij.
Aqua Cologniensis, f℥iss. M.
Sig. Apply after washing.

In some cases, especially where there is but little hair upon the scalp, the following ointment may be advantageously employed :—

℞. Sulphuris præcipitat. ʒss.
Vaselini, ʒiv. M.
Sig. A small quantity to be rubbed in once a day.

The amount of these applications and the frequency with which they are to be used must depend on the severity of the disease and the rapidity with which the scales are renewed after having been removed. The oil or ointment should be used after each washing.

The local treatment of seborrhœa occurring upon non-hairy portions of the body is in principle the same as that employed upon the scalp, but modified by the different condition of the parts. Thus the scales are more easily cleansed off by the simple application of soap and water, and ointments are to be employed preferably to oils. The applications are as a general thing to be made of less strength than is permissible on the scalp. In addition to those mentioned the following formula will be found very effective in seborrhœa of the body:—

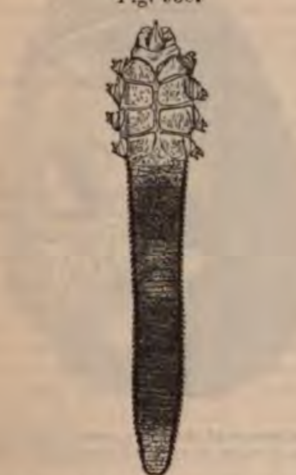
℞. Hydrargyri oxidi rubri, gr. x.
Vaselini, ℥j. M.

The prognosis of seborrhœa will depend upon the general condition of the patient and the probability of removing the cause. The length of time which the disease has lasted will also influence the prospect of early recovery. As a rule the affection is rather obstinate; months are sometimes required to alter the abnormal secretion. On the scalp the disease is apt to prove most intractable. When the hair has already begun to fall out a greater or less degree of baldness is apt to result in spite of every effort, and the utmost that can be promised is that the further ravages of the disease shall be stayed.

COMEDO.

Comedo is a disorder of the sebaceous glands, characterized by yellowish or whitish pin-head size elevations, containing in their centre exposed, blackish points. It is observed chiefly about the face, neck, chest, and back. Each single elevation is called a comedo (plural comedones). The common name "flesh worms" or "grubs" is calculated to convey the erroneous idea that the small inspissated plug of altered sebum which can be expressed from the follicle is a parasitic worm. It is true that a little mite, the microscopic demodex folliculorum (Fig. 930) is sometimes found in the mass, but this cannot be regarded as in any way essentially connected with the disease. Its presence is merely fortuitous and without significance. The affection, though trifling and without subjective symptoms, is often extremely annoying to patients. It is due in part to idiosyncrasy, in part to a general sluggish condition of performance, not only of the functions of the skin but of those of the whole body. Patients are apt to suffer from dyspepsia with constipation. In young women, chlorosis and menstrual difficulties are likely to be present.

Fig. 930.



Demodex folliculorum (Wilson).

Local treatment suffices in many cases to relieve the condition. Frequent bathing of the affected surface with hot water alone or with Castile soap, followed by friction, serves to stimulate the glands to activity, and tends to remove the inspissated secretion. A good plan when the comedones are conspicuously placed upon the face, and not too numerous, is to express each one separately, pressing upon it with a watch-key, the opening of which is placed directly over the black point. Previous bathing of the parts with hot water will aid this process of removal. Stimulating ointments, especially such as contain sulphur, are useful, as the following:—

℞. Sulphur. præcipitat., ʒj.
Ung. aquæ rosæ, ℥j. M.
Sig. To be rubbed in at night.

Sulphur lotions, such as those given under the head of acne, may also be useful. Should the skin tend to become harsh under the use of these remedies, weak alkaline ointments may be used for a time, as this:—

℞. Sodii biboratis, ʒss.
Glycerinæ, ♏xvj.
Ung. aquæ rosæ, ℥j. M.

The functions of the body should be carefully looked after, and any derangement corrected. Such hygienic measures as fresh air, out-door exercise, and cold bathing are all of benefit.

MILIUM.

Milia are those small, roundish, whitish, pearly, non-inflammatory elevations which are situated in the skin just beneath the epidermis, and which have their seat for the most part upon the face, although they may occur elsewhere upon the body. They may occur singly or in great numbers, and when formed may last for years without change. They give rise to no subjective sensations, and no annoyance beyond the slight disfigurement which they cause.

The affection consists in an accumulation of sebum within the sebaceous gland, which, owing to the obliteration of the duct, is unable to escape. If an incision is made into one of the little pearly milia, the more or less inspissated sebaceous matter may be expressed. Sometimes calcareous degeneration takes place in milia, forming the so-called *cutaneous calculi*. Milium usually exists without any general derangement of the skin.

The treatment consists in opening each of the little tumors with a knife, and squeezing out its contents. Frictions with soap and hot water are useful. In some cases the milia tend to return, and here the secreting gland must be destroyed by inflammatory action, excited either by the application of a drop of tincture of iodine after removing the contents of the milium, as Piffard recommends, or by electrolysis, as advised by Hardaway.

MOLLUSCUM SEBACEUM.

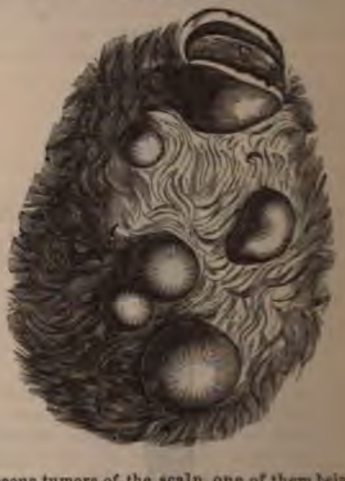
Molluscum sebaceum, which used sometimes to be called "molluscum contagiosum," though its contagious character has never been satisfactorily shown, is a disease of the sebaceous glands, characterized by rounded, semi-globular, or wart-like papules or tubercles, varying in size from a pin-head to a cherry. The color of the lesions is that of normal skin, or pinkish. Sometimes they are waxy—in fact they may resemble a drop of white wax upon the skin, or they may look like pearl buttons. Upon their summits they often show a little depression. They are usually found on the eyelids, neck, breast, and genitalia. Eventually the lesions disintegrate or slough. They give rise to no sensation or inconvenience.

Opinions as to the nature of the disease differ. By some the process is regarded as having its seat in the sebaceous glands, while others maintain that the affection is one of the rete mucosum. If one of the tumors be cut into with a knife the contents may usually be expressed, in the form either of a firm yellowish, roundish body, or of a milky or cheesy fluid. Molluscum sebaceum is to be distinguished from molluscum fibrosum, with which it is occasionally confounded. Molluscum sebaceum, however, consists in a collection of sebaceous matter, while M. fibrosum is a connective-tissue hypertrophy possessing a solid fibrous feel. As a rule, in M. sebaceum sebaceous matter may be squeezed out of the duct, the opening of which is usually to be seen as a darkish point in the centre of a slight depression on the apex of the tumor. Molluscum sebaceum occurs about the face, and is a disease of infancy and childhood, while M. fibrosum is more commonly found on the body and in adults. Local treatment is alone required in molluscum sebaceum. When the lesions are few and small, a stimulating application, as sulphur or white precipitate ointment, may be sufficient. In other cases the tumors may be opened and the contents expressed, after which the interior of the sac may be touched with nitrate of silver, or better removed by forceps, if possible. Occasionally the larger tumors may be excised. It must be remembered, however, that the affection tends to spontaneous recovery, and that, therefore, too vigorous treatment is to be avoided.

SEBACEOUS CYST.

Sebaceous cyst appears as a variously-sized, firm or soft, roundish tumor, seated in the skin or subcutaneous connective tissue. The skin covering the tumor is natural in color, or whitish from stretching. The tumors may occur singly or in great numbers. They may vary from the size of a pea to that of a walnut, and are firm, or more often soft and doughy. As a rule, they are freely movable, and are painless. Their favorite seat is upon the scalp, face, back, and scrotum. Usually they last for years, but sometimes break down and ulcerate. In old persons epitheliomatous degeneration may take place in them. In one variety of sebaceous cyst the duct is open, and

Fig. 931.



Sebaceous tumors of the scalp, one of them being laid open to show its cyst and contents (Gross).

the tumor is flat in form, tending to spread laterally rather than above the level of the skin. In the other variety, when the duct has become obliterated, the tumor assumes a semi-globular, or even a globular form, projecting considerably above the skin. This form is apt to occur on the scalp, when it is usually bare of hair. The contents of sebaceous cysts may be milky or cheesy. They are often decomposed and fetid. The tumors are, in fact, enormously distended sebaceous ducts and glands, the walls of which have become hypertrophied until they form a tough sac. The treatment of sebaceous cyst is excision. The cyst should be carefully dissected out, as otherwise the disease is apt to recur.

CLASS II.—INFLAMMATIONS.

ERYTHEMA.

Four varieties of erythema may be mentioned: *E. simplex*, *E. intertrigo*, *E. multiforme*, and *E. nodosum*. Of these, the first two are simply hyperæmic, with little or no inflammatory exudation, while the last two are characterized by more or less exudation of a plastic character. The erythemata disappear without leaving any mark or scar.

Erythema simplex is characterized by redness, occurring in the form of variously-sized, diffused, or circumscribed, non-elevated patches, irrespective of cause. There are two varieties: the idiopathic, under which head are included the erythemata occasioned by heat and cold, continued pressure or rubbing, and the action of irritant or poisonous substances, as mustard, arnica, various dye-stuffs, acids, and alkalies; and the symptomatic, due to some general derangement of the economy, as disorders of the stomach and bowels, etc. Certain general diseases are at times accompanied with hyperæmia of the skin, which shows itself in the form of roundish spots, the size of a pea or finger-nail, to which the name of *roseola* has been given. It denotes simply the form of erythema, and in no way indicates the nature of the disease which has brought it forth.

The treatment of erythema must obviously depend upon its cause in any given case. The removal of the obvious cause is alone usually sufficient in idiopathic erythema, but in the symptomatic form of the disease the internal disorder to which the cutaneous manifestation is due must be diligently sought out and treated with a view to removal. Locally, the various bland dusting-powders, as those to be mentioned under the treatment of acute eczema, or bland ointments, as simple vaseline, may be employed.

Erythema intertrigo is characterized by redness, heat, and an abraded surface with maceration of the epidermis. It occurs chiefly in those parts where the natural folds of the skin come in contact with one another, as about the nates, perineum, groins, axillæ, and beneath the mammæ, and is produced by the friction of two opposing surfaces. It is especially common among fat persons, women with pendulous mammæ, and infants whose skin is tender. The skin feels chafed, and becomes hot and sore. Perspiration also at times takes place, which macerates the epidermis, and gives rise to an acrid, mucoid fluid. If neglected, a true dermatitis may set in. The affection comes suddenly, and if taken in time may usually be quickly checked, but if not treated it soon becomes very annoying. Occurring between the nates, a common seat of the disease, it may interfere with walking. It is usually harder to cure in infants when the diaper, saturated with more or less acrid secretions, is constantly in contact with the skin.

The disease is one of summer rather than winter, although it may occur at any time of the year if sufficient cause be present. It is sometimes brought on by wearing rough under-clothing. I have known severe erythema intertrigo of the nates and thighs, caused by walking about after sea-bathing in wet bathing-clothes. The rough surface of the flannel, as it dries, becomes coated with minute acicular crystals of salt, which cut like tiny knives. The patient sometimes supposes himself to have been "poisoned" by a hired bathing dress, when the cause of his intertrigo is purely mechanical, as above mentioned.

The treatment of erythema intertrigo is commonly an easy matter. As a rule, very little is required beyond cleanliness and attention. The parts should be washed with cold water and Castile soap, and dried with a soft rag or towel. The folds of the skin are to be separated, and kept apart by pieces of soft linen or lint. Dusting-powders ordinarily constitute the best topical remedies. Starch, oxide of zinc, lycopodium, and French chalk are conveniently employed. The following is a good formula:—

R. Pulv. zinci oxidi, ʒij.
Pulv. amyli, ʒvj. M.

In cases which are obstinate, diluted lotio nigra, applied once or twice a day, alone, or followed by the use of some bland powder, as above, is an efficacious remedy. Dilute alcoholic lotions, or astringent lotions composed of alum or sulphate of zinc, a few grains to the ounce, also prove serviceable in stubborn cases.

In the case of infants, when the intertrigo is about the anus, and the stools are thin with an acid smell, the following powder may be given internally :—

℞. Calcis præcipitat., gr. iss.
Bismuthi sub-nitrat., gr. ij.
Sacch. alb., gr. iij. M.
Sig. One, thrice daily.

When the stools show casein, minute doses of hydrochloric acid may be given. In the severer forms of erythema intertrigo in infants, where milder measures fail, the following formula is said to be useful :—

R. Hydrarg. bichlor., gr. ij.
Aquæ distillat., ℥iv. M.

Pieces of lint are soaked in this solution and laid upon the diseased surface, three or four times a day for an hour at a time ; only rarely is it necessary to make the application continuous. I have never myself employed this treatment, but it is recommended on good authority, and is said generally to cure in twenty-four to thirty-six hours.

Erythema multiforme is characterized by reddish, more or less variegated, macules, papules, and tubercles, occurring discretely or in patches of various size and shape. The name has been given to this form of erythema on account of the protean character of the lesions which manifest themselves as erythematous patches of the most varied shapes and sizes, or as papules, vesico-papules, and tubercles scattered or in groups. Various names are given denoting the arrangement of the lesions. Thus we have *E. annulare*, occuring in circular patches; *E. iris*, occurring in concentric rings often of beautifully variegated colors, as red, purple, yellow, and blue. Sometimes the circles are very large, or are broken and assume gyrate forms ; this is *E. marginatum*. Distinct papules and tubercles occur in *E. papulatum and E. tuberculosum*. The former of these varieties is that in which the affection is commonly encountered. It shows itself in the form of isolated or aggregated flat papules of varied size and shape, bright red, bluish, or purplish in color, and which soon fade, seldom lasting longer than a week or ten days. E. tuberculosum is simply an exaggeration of this form, and all of the varieties mentioned are but forms and stages of the same process, and are often met with ; two or more occurring together simultaneously on the same individual. The lesions of E. multiforme disappear spontaneously, leaving perhaps slight pigmentation and desquamation.

Erythema multiforme is usually found on the backs of the hands, fingers, forearms, and legs, occurring simultaneously. It may show itself on the face and trunk. Sometimes it attacks the mucous membranes. Now and then it is general, involving the whole surface, usually in the erythematous form. A marked feature of the disease is the disproportion between its appearance and the subjective symptoms to which it gives rise. Notwithstanding the angry look which the eruption often assumes, there is very little itching or burning. Sometimes constitutional symptoms, as malaise, headache, rheumatic pains, and gastric derangement are present in marked cases.

The affection is much commoner in the spring and fall, although it sometimes occurs at other periods of the year. The papular form is sometimes brought on by derangement of the stomach, and runs a course resembling that of urticaria. Genito-urinary diseases are said to dispose toward the occurrence of the efflorescence. In the majority of cases no active treatment is called for ; light diet, the avoidance of stimulating drinks, mild saline laxatives, with the local application of dilute alcohol, or of carbolic acid, a drachm to the pint of water, will usually prove sufficient. Dusting-powders of equal quantities of starch and oxide of zinc are also useful.

Erythema nodosum is characterized by the formation of rounded or ovalish, variously-sized, more or less elevated reddish nodes. The disease is apt to be ushered in with some disturbance of the system ; the nodes often appear suddenly ; they may come on any part of the body, but are commonly found on the legs and arms. They vary in size from a small nut to an egg, are reddish in color, tending to become bluish or purplish. As they disappear they undergo various changes of color like a bruise, and it is often difficult to distinguish the lesions from ordinary contusions, especially when they occur over the shins. When the disease is at its height the lesions have a tense, shining look, as if they contained fluid, and often an indistinct sense of fluctuation is perceptible. They never suppurate, however. Not unfrequently they are more or less hemorrhagic in character. They vary in number from a few to a dozen or more. They come out as a rule in crops. They are painful or tender on pressure, and are usually attended by burning sensations. Sometimes the lymphatic vessels are involved. The affection terminates in spontaneous recovery in two to four weeks. An "ominous" form has been described when the eruption is the precursor of tuberculous disease. I met such a case several years ago in a little boy, in whom, after the disease had lasted for three or four weeks, symptoms of tubercular meningitis showed themselves, to which the little patient finally succumbed. This form is very rare. In fact the disease itself is a rare one, but 27 cases occurring in the 16,863 cases of skin disease recorded in the statistics of the American Dermatological Association.

No active treatment is called for. Rest in the recumbent posture, the correction of any functional derangement; quinine, if required, is all that will usually be needed. If there is a tubercular family history, I should be inclined to give cod-liver oil from the beginning.

URTICARIA.

Urticaria is an inflammatory affection characterized by the development of wheals of a whitish or reddish color, accompanied by stinging, pricking, tingling sensations. The disease shows itself by the sudden formation of wheals, of variable size, shape, and color. Sometimes these are no larger than a split pea; at other times they may be as large as the palm or larger; usually they are small finger-nail sized. The larger patches are made up of a number of small ones which have coalesced. While the smaller lesions are usually round, the larger ones may be very irregular, crescentic, or linear; often they assume a grotesque outline. They may be barely elevated above the skin or several lines in height. They are at times soft to the touch, at other times quite firm. In color they may be whitish, pinkish, or reddish. When they occur on the face, they may give rise to great temporary deformity. The lip, or half the lip, for instance, may within a few minutes swell out to a great size and remain thus for an hour or more. The eruption burns, stings, and tingles, as if the skin had been stung by nettles; hence the popular name "nettle rash" applied to the affection. Sometimes these sensations are merely annoying, at other times they may prove distressing to the last degree. Rubbing and scratching commonly aggravates the disease, bringing out new wheals.

Urticaria, as it usually occurs, is one of the most ephemeral of skin-diseases. I have often been called upon to treat cases where the wheals could never be seen, although between the patient's visits to me they had appeared in large crops. The disease frequently changes its locality, the eruption appearing now in one part of the body and now in another. It occurs at all ages and in both sexes. Its duration depends entirely upon the presence or removal of the exciting cause. There are several varieties: 1. *Urticaria papulosa*, which occurs commonly among children, in the form of widely dispersed, pin-head, to split-pea sized, flat or acuminated papules, which appear suddenly and last for hours or days. It is attended by intense itching. 2. *Urticaria hemorrhagica*, which is in fact urticaria occurring in the seat of a purpuric eruption. 3. *Urticaria bullosa*, where the wheals are transformed into blebs which may assume the characteristics of pemphigus. 4. *Urticaria tuberosa*[1] occurring in the form of large-walnut or even egg-sized, firm, more or less persistent nodes or tumors, resembling somewhat exaggerated lesions of erythema nodosum.

Urticaria, according to the duration of the disease, may be described as acute or chronic. The acute variety is commonly, though by no means invariably, ushered in by slight febrile symptoms, languor, headache, depression, gastric disturbance, furred tongue, etc. The efflorescence appears suddenly, and may involve the whole body or a portion only, accompanied by intense and almost intolerable burning and stinging sensations. In a variable time, from an hour to a day, the symptoms subside, and the eruptions disappear without leaving a trace unless in the form of scratch-marks. The termination of the attack is greatly influenced by the removal of the exciting cause, as well as by active treatment. Relapses may take place. Chronic urticaria may continue for months or years, or, indeed, as long as the cause exists. The individual wheals come and go as in the acute form; the lesions, however, are usually smaller. Crop after crop may appear, the skin being hardly ever free from them. The patient's general health may appear fair.

The causes of urticaria are numerous, and of a very diverse character. Certain external irritants and poisons to the skin, as the stinging nettle, jelly-fish, caterpillars, fleas, bedbugs and mosquitoes, are not infrequent causes. Among internal causes, gastric and intestinal derangements are by far the most common; they in fact are the cause of the majority of acute urticarias. An over-loaded stomach, excess in wine, beer, or highly seasoned food may occasion an attack, while certain articles of food, as fish, oysters, clams, crabs, lobsters, pork, especially sausage, oatmeal, mushrooms, raspberries, and strawberries are all apt to bring out the eruption. A number of medicinal substances may also bring on an urticarial eruption[2] in some individuals. In most cases of urticaria from these causes, a certain idiosyncrasy seems to exist. Any irritation of the bowel, as of worms in children, may bring out the eruption. Sudden emotion or unusual excitement in certain persons may also produce it. In females menstrual and uterine difficulties may cause urticaria. The disease is intimately connected with the nervous system, and patients with chronic urticaria are apt to be persons of more or less depraved nervous organization.

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[1] A monograph by Milton under the title "Giant Urticaria," gives an account of two cases of this eruption, with a striking portrait of the lesions, London, 1878.

[2] See under Medicinal Eruptions.

The diagnosis of urticaria does not often present any difficulty. The peculiar and evanescent character of the eruption, the excessive burning and tingling, and the anatomical appearance of the wheal, all serve to differentiate the disease.

The treatment of urticaria depends greatly for its success upon the discovery and removal of the cause. When this is suspected to be some gastric disturbance, the precise articles of food which the patient has been partaking of should be inquired into; their quality as to freshness, etc., should also be a matter of scrutiny. The possibility of the patient having eaten anything unusual should also be considered, as well as the previous ingestion of medicine. An emetic may be given in acute cases, if the contents of the stomach have been recently ingested, and are suspected of being the cause. The bowels also should be freely opened by a saline purgative. The diet should be of the most simple and unstimulating character, and the subsequent internal treatment should be directed against the digestive difficulty. The treatment in any given case must depend upon the result of a careful investigation into its nature and cause.

The laxative mineral waters, Friedrichshall, Hunyadi Janos, Ofner Rakoczy, or the alkaline waters, as Vichy or Saratoga Vichy, may at times be used with advantage. Diuretics are often of use. Quinia is a most useful remedy whether symptoms of malaria are present or not. Arsenic is sometimes of service when other remedies fail. Iron also is useful. Bromide of potassium, chloral, and other sedatives may be required to give rest and calm to the nervous system often injured by long suffering. Tincture of gelsemium, as recommended by Bulkley, in pruritus, may probably prove useful. I have not yet had an opportunity to try its virtues.

The local treatment is of importance, the burning and stinging sensations peculiar to this disease being extremely distressing. Irritating underclothing should be avoided, and the patient should sleep in a cool room with as little covering as may be. Baths and lotions are the most available applications. The following local remedies may be mentioned; when one fails, another should be tried. Sponging with vinegar and water, or alcohol in the form of whiskey, alone or diluted, often gives relief; it should be employed frequently. Salt-water baths may be mentioned. Alkaline baths, containing three ounces each of the carbonate of sodium and the bicarbonate of potassium to thirty gallons of water, may often be used with advantage. A handful of starch boiled in a quart of water, or a double handful of bran tied up in a bag, which is then squeezed like a sponge in the water of the bath, until this becomes milky, may be added with benefit. Gelatine (1 to 3 lbs.) may also be added to the alkaline bath. Sometimes a bath containing one to two ounces of sulphuret of potassium, serves to allay irritation. Acid baths, containing hydrochloric or nitric acids, half an ounce to thirty gallons of water, are also recommended. Carbolic acid, as in the following formula, is one of the most generally useful prescriptions:—

℞. Acid. carbolic, fʒij, ad fʒiij.
Glycerinæ, f℥j.
Aquæ, Oj. M.

I have sometimes found benzoic acid, five to ten grains to the ounce of water, efficient, and borax in the same strength may be used. Chloral, ten to twenty grains to the ounce; chloral and camphor of each a drachm to one ounce of simple cerate; chloroform, a drachm to the ounce of rose ointment, or as a lotion, a drachm to the ounce of alcohol, or even alone, I frequently find most grateful in allaying the burning and stinging; corrosive sublimate, five grains to the pint of water, or the following formula, may be employed in some cases:—

℞. Hydrarg. bichlor., gr. ij.
Acidi hydrocyanici dil., fʒij.
Emuls. ol. amygdalæ, f℥xij. M.

The dilute hydrocyanic acid may be used alone in the strength of one to three drachms to the pint, and bromide of potassium, from four to eight drachms to the pint, may likewise prove serviceable. Acid lotions, as for example of acetic and citric acids; dilute ammonia-water and carbonate of ammonia, ten to twenty grains to the ounce, may likewise suit some cases.

The prognosis in urticaria varies in each case. If the cause is a temporary gastric derangement, its removal will soon result in a cure. If, however, the urticaria is chronic and dependent upon some derangement of the nervous, digestive, or generative system of long standing, it is apt to prove very stubborn.

Under the name *urticaria pigmentosa*, a rare and obscure form of the disease has been described; occurring first in infancy, it is apt to last for years. Cases have been well reported by Tilbury Fox[1] and others in England,[2] and by Morrow in this country.[3]

ECZEMA.

Eczema is an inflammatory, acute or chronic, non-contagious disease of the skin, characterized at its commencement by erythema, papules, vesicles, or pustules, or a combination of these lesions, accompanied by more or less infiltration and itching, terminating either in discharge with the formation of crusts, or in desquamation. It is eminently a protean disease. At one time it begins as an erythema; later this may become moist and secreting, and finally terminate in a thickened dry desquamative surface. At another time, the affection may begin in the form of vesicles or pustules with swelling and heat. These soon burst, and a red weeping surface results, which is soon coated with bulky crusts from the drying of the liquid gummy discharge. The character of the patch may then suddenly change, and instead of a weeping surface, there may exist a dry, scaly, infiltrated, fissured piece of skin which continues until the disease is removed. Or, again, papules may first appear; these may remain as such throughout their course, or may pass into other lesions, or they may be associated sooner or later with vesicles.

There is no other affection of the skin in which the lesions undergo such sudden and manifold changes, and every variety may manifest itself in turn upon the same individual.

More or less itching is almost always present in eczema. It may vary in degree from the merest titillation to unendurable torture. Sometimes burning takes the place of itching; at other times, they occur together. But eczema is the itching disease *par excellence.*

Eczema may be acute, running its course in a few weeks and then permanently disappearing, or it may be chronic and continuous or recurring through years. It may occur in small patches, single or multiple, or more rarely covering extensive surfaces. Unless very extensive it is not ushered in by constitutional symptoms.

The varieties of eczema are named according to the lesions which the disease assumes at its beginning. These are as follows:—

Eczema erythematosum. — This form shows itself in typical cases, first as an undefined erythematous state of the skin, occurring in small or large patches without discharge or moisture. Commonly, the patch, which is sometimes slightly infiltrated, is covered with fine thin scales of epidermis, and now and then the surface is slightly excoriated. The skin may be bright or dark red, or even violet. It often has a yellowish tinge. It is occasionally mottled. The process may affect a small surface or a large one; it is often better one day, and worse the next, as it may even go away entirely only to return a little later. It is apt to be chronic, and the relapses are annoying and discouraging, especially in winter time. The influence of exposure to external heat or cold, a heavy meal or indulgence in alcoholic drink, is apt to be followed by an exacerbation of the disease. Burning and itching, alone or together, are prominent symptoms. Eczema erythematosum may run its course as such, or may develop into E. squamosum. Vesicles or pustules are rarely seen. E. erythematosum is most apt to occur upon the face[1] and genitals.

Eczema vesiculosum.—Vesicular eczema commonly begins by a feeling of heat and irritation in the part, which shows a diffused or punctate redness with itching and burning, and small vesicles soon show themselves, either alone or grouped or sometimes running together. They are soon filled with a yellowish gummy fluid, and then they ordinarily break and form a crust. Sometimes, however, the vesicles simply dry up without breaking. In more marked cases new crops of vesicles continue to come out, and when a considerable surface is covered the quantity of fluid poured out is quite large, and the underclothing or dressings are saturated. When the secretion dries it is very itchy and tenacious, and this is characteristic of this form of eczema. Typical eczema, as described, is not as common as the more complex varieties where the lesions are multiform; papules, papulovesicles, vesicles, pustules, and other lesions being found in conjunction. The two chief characteristics of this form of eczema, wherever found, are the itching and the gummy secretion.

Vesicular eczema may occur in very small patches or in quite extensive areas. As it shows itself in children over the face and scalp it forms the eruption popularly known as "*milk crust,*" "*tooth rash,*" *or* "*moist tetter.*"

Eczema pustulosum (eczema impetigino-

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[1] Under the name of xanthelasmoidea, on account of its resemblance to xanthelasma or xanthoma, he gives a plate representing the affection in his Atlas of Skin Diseases.

[2] See Duhring, l. c., 2d ed., p. 155.

[3] Archives of Dermatology, Jan., 1879.

[1] A most excellent portrayal of the affection as it occurs on the face, is given in Prof. Duhring's Atlas; Plate A.

sum).—Pustular eczema is very much the same in its original appearance as vesicular eczema, only that the lesions assume the form of pustules rather than of vesicles. There is usually less heat and itching. A strict line cannot be drawn between the two forms, for they are apt to run into each other, and may coexist on the same subject, and in the same patch. The scalp and face are favorite seats of pustular eczema,[1] and it is apt to occur in children who are badly nourished or who are being brought up by hand. It also commonly occurs in ill-fed and scrofulous adults.

Eczema papulosum. — Papular eczema appears in the form of small round or acuminated papules varying in size from a small to a large pin-head. In color, the lesions are bright or dusky red, sometimes violaceous. They may be discrete, or may run together, forming large patches, and these are often infiltrated. Now and then they become abraded and moist, forming eczema rubrum. Papular eczema is apt to occur on the arms, trunk, and thighs, especially the flexor surfaces.[2] It may involve a very small surface, or it may cover a large area of the body, and it is apt to be the most stubborn, troublesome, and annoying of all the forms of eczema. Itching is the most prominent and troublesome symptom; at times this is agonizing. Patients tear and gash themselves in their efforts to gain relief, and I have seen chronic cases where the nails have been worn to the quick, and the ends of the fingers polished, with the almost ceaseless efforts of the patient to assuage momentarily the torment.

Eczema rubrum.—This must be regarded rather as a secondary condition resulting from previous morbid action than a distinct variety. It is a variety only in a clinical sense. It may result from eczema erythematosum, vesiculosum, pustulosum, or papulosum. In eczema rubrum the surface of the skin is inflamed and infiltrated, red, moist, and weeping; occasionally it is more or less covered with yellowish or brownish crusts, often completely covering the part.[3] Unless artificially detached, these crusts may sometimes continue to adhere, the process of exudation meanwhile going on underneath. Under these circumstances the appearance of a rough, dirty, yellowish, or brownish scale is observed instead of the shining red, oozing surface. Eczema rubrum may occur upon any part of the body, although it is most commonly found upon the legs or the flexures of the joints.

Eczema squamosum.—Scaly eczema is an important clinical variety of the disease. Like E. rubrum it may follow and result from the erythematous, vesicular, pustular, or papular forms of the disease. It is particularly apt to succeed erythematous eczema. When typical, it shows itself in the form of variously sized and shaped reddish patches, which are dry and more or less scaly. The skin is always more or less infiltrated or thickened.[1] Squamous eczema may be only an ephemeral stage in the evolution of the disease. More commonly, however, the term is applied to denote a chronic condition which may last for a long time.

Other lesions are encountered in eczema which are worthy of mention. These are, rhagades, or fissures occurring when the disease and infiltrated skin becomes cracked by flexure, as about the joints or at the margins of the lips or anus. Chapped hands, for example, are typical instances of fissured eczema. Sometimes eczema may assume a warty condition, and at other times hard sclerosed patches may form.

In addition to the clinical varieties of eczema above described, the disease may fitly be divided into varieties according as it assumes the acute or chronic form. The division, which is a distinct one, refers not so much to the actual duration of the disease as to the pathological changes which occur during its course. When the general inflammatory symptoms are high, and the secondary changes insignificant, the disease may be said to be acute. When, however, the process has settled into a definite course, the same lesions continually repeating themselves, accompanied by secondary changes, the disease is to be considered chronic.

Eczema is, in this country at least, by far the commonest of skin diseases.[2] It attacks persons in all grades of society, and occurs at all ages and in both sexes. In some cases it appears to be in a certain sense hereditary. I have found it commonly in the children of persons of light complexion, with fair to reddish hair, with a tendency to scrofulous affections. Some persons are so prone to eczema that the slightest provocation will bring on the eruption, and an attack of dyspepsia which in another person would have no effect on the skin, or contact with an irritant which in most persons would only cause a transient dermatitis, are in such individuals a sufficient cause to bring out an eczematous eruption. Dyspepsia and constipation are among the commonest constitutional causes of eczema. In certain individuals the presence of an excess of uric acid and urates in the system is sufficient to produce and keep up eczema. The occurrence of gout and rheumatism in connection with eczema, has often been alluded to by writers. I am inclined, however, to think that gout is among the rarer exciting causes. It is certain, indeed, that this disease is rare among the younger generation in Philadelphia, and I may say, so far as my personal experience goes, that in some three thousand cases of eczema which I have had under observation, not a single one has occurred in connection with the gouty diathesis. Improper food, as to quantity or quality, acts as an exciting cause. During the period of commercial depression which occurred some few years ago, I found many working people the subjects of eczema, clearly brought on or much aggravated by coarse and insufficient food. It is, however, among infants and young children that this cause of eczema most frequently comes into play. Pregnancy and lactation, debility, nervous exhaustion, excessive mental or bodily work, dentition, vaccination, internal irritation, as of ascarides or tænia in the bowels, may also determine the eruption of eczema.

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[1] See Duhring's Atlas of Skin Diseases, Plate Y.

[2] See Duhring's Atlas of Skin Diseases, Plate X.

[3] See Duhring's Atlas of Skin Diseases, Plate O.

[1] See Duhring's Atlas of Skin Diseases, Plate I., which represents a typical case of squamous eczema occurring on the back of the neck.

[2] The comparatively large space which has been given in this article to the consideration of eczema may be accounted for by the statement that more than one-third of all cases of skin-disease met with in this country are eczematous in character. The statistics of the American Dermatological Association (Trans. Amer. Derm. Assoc., New York, 1879) show 6179 cases out of 16,863 cases of skin-disease. In Philadelphia it occurs in the proportion of forty to fifty per cent. of all skin cases. It is otherwise in Europe; Hebra, in Vienna, out of 29,535 cases, records only 2195 of eczema.

Eczema is not contagious. It cannot be acquired from being in contact with or handling the discharge.

Among the local causes of eczema which are numerous and important, and which give rise to the condition known as "artificial eczema," are certain cutaneous irritants, as croton oil, mercurial ointment, tincture of arnica, tincture of cantharides, mustard, antimonial ointment, sulphur, and turpentine. Here, also, may be mentioned the rhus venenata and toxicodendron, the poison oak and ivy, which, although usually giving rise to dermatitis, may, under some circumstances, and in certain individuals, give rise to true eczema. Heat and cold, excessive perspiration, especially about the genitalia and other places where the skin inclines to form folds, may give rise to the affection, which, under the latter circumstance, is known as *eczema intertrigo*.

Eczema is of much commoner occurrence in the winter than in the summer. The atmosphere of January and February, and particularly the cold, bleak weather of March, seem to favor the occurrence of the disease.

Many cases of eczema get well in summer only to recur again in winter. Water, as in water-dressings or fomentations, or in the inordinate use of bathing, may be a cause of eczema. The insensate declamation against filth, or want of personal cleanliness, as an almost universal cause of skin diseases, which is too common not only among superficial writers but among physicians who ought to know better, would in many cases be better replaced by a caution against excessive ablution. The custom of very frequent bathing, especially when soap is used, is often harmful to the skin to a considerable degree. Alkalies, acids, strong and harsh soaps, may give rise to chapping and fissuring of the skin and to eczema. Some years ago, when the view that sapo viridis was a sort of specific in diseases of the skin was prevalent, I frequently saw severe and extensive eruptions of eczema which had been brought about by the injudicious or improper employment of this semi-caustic application. Finally, among the local causes of eczema may be mentioned the irritation caused by the presence of lice and the itch-mite, together with the scratching to which they give rise.

The diagnosis of eczema is of great importance, especially as the disease shows itself in such protean forms. There are, however, certain features of eczema, one or more of which are present in every form of the affection, and these may serve to aid in the diagnosis. Infiltration of the skin exists to a greater or less degree in all cases of eczema. It is indicated by a certain thickening of the skin, which may usually be seen by the eye, and in most places detected by rolling a small pinched-up portion of the skin between the finger and thumb. Swelling and œdema exist in all acute eczemata, and often in chronic cases. The patch is red and congested. In most cases of eczema there has been more or less fluid exudation or moisture at one stage or another in the history of the disease. This is termed weeping, discharging, or running. The fluid may be clear, limpid, and yellowish, turbid, and puriform, or it may contain blood. This discharge is a most characteristic feature of eczema, and is not present in any other disease. The crusts formed by the drying up of the discharge are characteristic. When this has been copious, the crusts form rapidly, and in quantity so as sometimes to cover and mask the skin. They are yellowish, brownish, or greenish in color, and when removed show a moist surface beneath.

Among the most important diagnostic symptoms of eczema is the subjective one of itching. It is often intense, being more marked than in other diseases. It is never altogether absent, though it may vary much in degree. Burning is also a not unfrequent subjective symptom, being more apt to be present in erythematous eczema, and often giving way to itching as the disease progresses. The itching of eczema often gives rise to an irresistible inclination to scratch, as was noted in speaking of the papular variety of the affection.

The diseases with which eczema is most likely to be confounded are the following: *Erysipelas* sometimes resembles eczema erythematosum, especially as it occurs upon the face. It is, however, acute; it begins at a given point and creeps slowly from place to place. The inflammation is a deep one; the surface is smooth, shining, tense, and more or less dusky red, while deep infiltration, œdema, heat and swelling exists underneath. Erysipelas is also accompanied by considerable fever and constitutional disturbance. There is no discharge in erysipelas save that from the bursting of bullæ, which sometimes form during the later stages of the disease. *Urticaria*, particularly that variety accompanied by formation of small papular lesions, is occasionally mistaken for eczema papulosum. The irritable condition of the skin, the history of itching and burning appearing before the occurrence of the lesions, and the comparatively evanescent and recurrent character of the lesions, all characterize urticaria in contradistinction from eczema. *Herpes zoster* sometimes resembles eczema vesiculosum, but is distinguished from it by the arrangement of the vesicles, the more regular grouping of the lesions of zoster along the line of some well-known nerve trunk, and the ordinary occurrence of neuralgia in connection with the zoster eruption. *Seborrhœa*, as it occurs in the dry form upon the scalp, is often very difficult to distinguish from eczema squamosum occurring in the same locality. The difficulty of diagnosis is occasionally enhanced by the simultaneous occurrence of both affections upon the same individual. In eczema, however, the scales are larger, less abundant, less greasy, and drier than in seborrhœa. Eczema is more apt to occur in a patch on the scalp, while seborrhœa is more generally diffused. The skin in eczema is usually red and inflamed, and is always itchy; in seborrhœa it may be even paler than normal, and may have a dull leaden hue. It is commonly less itchy.

Psoriasis is often confounded with eczema, the diseases when occurring in limited patches or upon the scalp being sometimes almost indistinguishable. Old infiltrated inflammatory patches are especially difficult to make out, but in psoriasis the edges usually terminate abruptly, while in eczema they are more apt to fade into the surrounding skin. The scales on eczema patches are thin and scanty; on the patches of psoriasis they are comparatively more abundant, larger, silvery, and imbricated. In eczema there is usually some history of moisture or weeping in one stage of the disease or another; in psoriasis the process is always dry. The distribution of the disease, and the occurrence of patches on other parts of the body, may aid in the diagnosis. In doubtful cases, where only a few scattered lesions are presented for examination, the whole surface should be diligently searched over, for a single lesion in some part of the body may, by its typical aspect, betray the nature of the disease where the majority of the lesions are quite doubtful in appearance. *Lichen ruber* may be confounded with eczema, but the peculiar shape of the lesions in L. ruber planus, to be described further on, together with their dusky hue, and the fact that they run a quiet, chronic course without change and leave a deep stain behind, all seem to distinguish this affection from eczema.

Pityriasis rubra is a very rare disease, and is so seldom met with in this country, but two authentic cases I believe being on record, that its description does not come within the scope of this article.[1] The only form of eczema with which it is likely to be confounded is *E. squamosum universalis.* It may be distinguished from eczema, however, by its uniform redness; great masses of large, thin, papery, whitish, epidermic scales, which continually reproduce themselves; slight itching, burning heat, and lastly by the absence of marked infiltration and thickening of the skin, a symptom common in eczema.

Tinea circinata is sometimes mistaken for eczema, but the course of the two diseases is quite different, and the microscope will almost invariably settle the question of diagnosis by showing the presence or absence of the characteristic fungus. Ring-worm of the scalp in its milder and more chronic stages may readily be mistaken for eczema; the diagnostic points will appear in the description to be given of that affection later on.

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[1] A full description may be found in Duhring, loc. cit., p. 302.

Sycosis, both of the parasitic and non-parasitic varieties, sometimes resembles eczema of the beard. The former, however, is scantily crusted, and when the crusts are removed, instead of the smooth, soft surface of eczema, a rough dusky-red mamillated surface is revealed. The loose hairs are also loaded with the characteristic microscopic fungus about their roots. Sycosis non-parasitica is essentially an inflammation of the hair follicles, and, while eczema is superficial, sycosis leaves the surface alone, and involves the follicles only.

Favus sometimes resembles eczema, but the peculiar yellow color of the favus crusts is almost unmistakable, and the microscope will quickly settle the question of diagnosis, for the peculiar fungus of favus is very abundant in the lesions of this disease.

Scabies is very likely to be confounded with eczema, and *vice versa*, and the diagnosis is often difficult. This can easily be understood when it is considered that the eruption of scabies is in fact largely an eczema. Eczema, however, does not show the marked preference for certain localities, as the hands and fingers, buttocks, axillæ, abdomen, mammæ, nipples, and penis, which scabies displays. But chiefly the presence or absence of the peculiar burrow of the itch insect will decide almost invariably between the two affections, and the success or non-success of the anti-parasitic treatment will settle the question.

Syphilis.—Eczema of the scalp is at times liable to be mistaken for syphilis. There is a form of pustular eczema, characterized by the presence of a few scattered lesions of the scalp, without a sign of disease elsewhere, which it is sometimes difficult to differentiate from the pustular syphiloderm of the scalp. The occurrence or absence of a history of syphilis, or of concomitant syphilitic lesions in other parts of the body, and the success or failure of a treatment other than anti-syphilitic, will demonstrate whether one or the other affection is present. Occasionally fissures with abundant purulent secretion occur on the scalp in the course of syphilis, and this form of the eruption may closely resemble confluent pustular eczema. I have described such a case where the diagnosis was extremely difficult, and where even the ordinary anti-syphilitic remedies failed for a time to give relief. The disgusting odor accompanying the syphilitic disease will usually, however, serve to distinguish it.

In an article like the present it is obviously impossible to do more than indicate in a general way the plans of treatment suitable for the various forms of eczema. The reader is referred to the text-books on the subject, and especially to the various monographs published in this country and abroad, which deal with the subject in a more comprehensive manner.[1]

Eczema is a perfectly curable disease, but for its relief both internal and external remedies must at times be employed. Constitutional remedies, judiciously employed, are almost always needful, and prove of decided benefit in the majority of cases. In some cases, as when the eruption is local and due to some external irritant, or when it is exceedingly limited in extent, no internal measures are called for. The subject of diet must be carefully attended to; all articles which are difficult of digestion must be avoided, and especially salt or pickled meats, pastry, cabbage, cheese, and beer or wine. The bowels should be carefully regulated; dyspepsia is often the sole exciting cause of eczema, and the physician who desires to treat this affection in any of its forms with success, should be prepared to deal with dyspepsia in the majority of cases. The condition of the kidneys should be looked into. Diureties are frequently of value. Saline laxatives are very frequently called for in the treatment of eczema, and among these the following tonic aperient, devised by the late Mr. Startin, of London, is one of the best:—

℞. Magnesii sulphatis, ℥j.
Ferri sulphatis, gr. iv.
Sodii chloridi, ʒss.
Acidi sulphurici dil., ʒij.
Infus. quassiæ, ad ℥iv. M.

Sig. A tablespoonful in a tumbler of water before breakfast.

This preparation, though extremely disagreeable on first taking, becomes less re-

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[1] Archives of Dermatology, vol. ii., p. 217.

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[1] Among these, the following may be especially mentioned:—

On the Treatment of Eczema, by R. W. Taylor, M.D. (a Series of American Clinical Lectures, edited by E. C. Seguin, M.D., vol. ii., No. 11). New York, G. P. Putnam's Sons, 1876.

Analysis of One Thousand Cases of Skin Disease, with Cases and Remarks on Treatment, by L. Duncan Bulkley, A.M., M.D., American Practitioner, May, 1875.

Analysis of Seven Hundred and Seventy-four Cases of Skin Disease, etc. Bulkley, New York Medical Journal, April and June, 1877.

On the Management of Infantile Eczema. Bulkley, Transactions of the Medical Society of the State of New York for 1880.

On the Use of Water in the Treatment of Diseases of the Skin. Bulkley, Chicago Medical Journal and Examiner, January, 1880.

volting after using for a short time, and most persons, even delicate women, can take it without repulsion. The various ingredients may be altered in quantity in various cases to suit circumstances, but it is not often necessary to make any change excepting as to the sulphate of magnesia, which must often be increased in quantity if a full aperient effect be desired. The laxative mineral spring waters, as the Hathorn and Geyser springs of Saratoga, or the Friedrichshall, Hunyadi Jaños, and Ofner Rakoczy among German mineral waters, the latter mentioned in the order of their increasing purgative qualities, are beneficial in many cases. In infantile eczema the simple unspiced syrup of rhubarb in repeated small doses, alone or with magnesia, is often found desirable. Occasionally at the beginning of treatment, in sthenic, robust cases, and when there is a good deal of activity of inflammation, a brisk mercurial purgative is indicated. Especially is it necessary when the patient is suffering from constipation when first seen. Here the bowels are to be thoroughly unloaded, to begin with, and then we may enter upon the more direct treatment of the disease. In old persons, particularly when the patient has been a high liver, or is gouty or rheumatic, diuretics and alkalies are indicated. In such conditions the following prescription is recommended by Tilbury Fox:—

℞. Magnesii sulphat., ʒiv.
Magnesii carbonat., ʒj.
Tinct. colchici, ♏xxxvj.
Ol. menth. pip., ♏ij.
Aquæ, f℥vij. M.

Sig. Two tablespoonfuls in a wineglass of water every three or four hours.

The acetate and carbonate of potassium in full doses, and also the alkaline natural mineral waters, may be employed. In persons of debilitated constitution, or in scrofulous persons, particularly in the badly-nourished children of tuberculous parents, cod-liver oil is demanded, and is frequently very useful. Iron in various forms is to be recommended in some cases. The following prescription is one which I often employ with satisfaction:—

℞. Tinct. ferri chlor.,
Acidi phosphorici dil., āā f℥j.
Syrupi limonis ad f℥iv. M.

Sig. A teaspoonful in a wineglass of water after meals.

Syrup of the iodide of iron and wine of iron are also eligible preparations, particularly for children. Quinine and strychnia are sometimes called for by the general condition of the patient. Arsenic is useful in a limited class of cases, more especially in the chronic papular form and the squamous stage of the affection. In former times the use of arsenic in eczema of all grades and varieties was much abused, and even now it too often forms that routine treatment which is the refuge of ignorance. Frequently, so far from doing good, it does harm by upsetting the stomach, and its use is particularly pernicious in the acute and inflammatory forms of the disease. An admirable *resumé* of the value and indications for the employment of arsenic in skin diseases in general is given by Duhring.[1] Tar has been used internally in some chronic cases with benefit. Sulphur-spring waters are also said to be useful occasionally. I have had no personal experience with these latter remedies.

Regarding local treatment, ordinary water may be employed for washing purposes in most cases; when the skin is delicate and sensitive, distilled water or some of the mucilaginous waters made from bran-flour may be substituted. A very good method of softening the water, particularly when it is to be applied to the face, is to take a handful of bran, sew it up in a small linen bag, and squeeze the bag like a sponge through a basin of water until the water is quite milky. This gives a soft and agreeable quality to the water when it is applied to the skin. The water may be used cold or warm as best suits the fancy or feelings of the patient; but the most important point is not to use too much of it or too often. The best rule for the use of water in eczema is to use it as seldom and as sparingly as possible. The only two indications for its employment are either the removal of crusts or the cleansing from absolute and unendurable assoilment; water sometimes seems to act almost like poison upon the skin in eczema. White castile soap is ordinarily the only soap necessary to cleanse the skin of crusts and scales, but occasionally the stronger potash soaps, the ordinary household soft-soap, or the sapo viridis of Hebra must be brought into play. Sometimes the tincture of green soap, or "spiritus saponis kalinus," may be used instead of the solid soaps. Whatever soap is employed, it should always be subsequently completely washed off the skin, unless a distinctly caustic effect is desired.

The local treatment of eczema is of great importance; many cases can be cured by outward applications alone, and there are very few where these can be dispensed with entirely. Before instituting local treatment, the part affected should be examined with the view of determining whether the disease is acute or chronic, and what the characteristic lesions, the amount of heat, redness, swelling, etc.; and also the condition of the epidermis, whether intact or torn and abraded. It is most important also to ascertain the area involved, whether this be great or small, for not only must we be on our guard not to use irritant remedies, but it must be remembered also that some applications are poisonous by absorption when applied over large raw surfaces.

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[1] Loc. citat. Part I., Treatment, p. 86.

In most cases of eczema there are certain secondary products, crusts, scales, and extraneous matter which must be removed before the local remedies can be advantageously applied. Sometimes it is a matter of difficulty to induce patients to remove these extraneous matters, but it should be insisted upon, for it is useless to make applications outside of the crusts, though this procedure is not unfrequently observed when the physician has not given explicit directions for the proper cleansing of the surface. Crusts, if not extensive, may be removed by the use of hot water and soap, but if thick and tough, warm olive oil inunctions may be used previously to soften the mass. In some cases poultices must be used.

Two general principles may be mentioned in regard to the local treatment of eczema. These are, first, that in the acute form the treatment can scarcely be too soothing; secondly, that in the chronic form, the treatment can scarcely be too stimulating. Of course these general principles must be modified somewhat according to individual circumstances, especially with regard to the latter.

Acute eczema.—When a remedy is to be applied for the first time in a case of acute eczema, it is usually better to use it over a limited area until its effect is perceived, for it must be borne in mind that a remedy which has been of service in one case will not necessarily suit another, even when the general features of the disease are the same. If one remedy does not suit, another must be tried, for it is often difficult to decide beforehand what application will be most useful. The indication is to give ease to the patient, and medicaments must be changed if necessary until this end is attained.

In acute vesicular or erythematous eczema, water is as a rule injurious and irritates the skin. It should never be used except in cases of extreme necessity for the absolute needs of cleanliness. Patients, especially those belonging to the more refined classes, will sometimes rebel when desired, for instance, to abstain from washing the face, but occasionally uncleanliness, or what passes for such, must be enforced. In the place of washing, the surface may be powdered from time to time with a dusting-powder, such as the following:—

℞. Pulv. amyli, ʒvj.
Pulv. zinci oxidi, ℥iss.
Pulv. camphoræ, ʒss. M.

The following plan of treating acute vesicular eczema is that of Dr. James C. White, of Boston, which I learned from Dr. Duhring, and have used in hundreds of cases with great satisfaction. I consider it perhaps the best treatment for the majority of cases: The affected part is to be bathed with lotio nigra, either in full strength or else diluted with an equal part of lime-water applied by means of a sponge, or occasionally by means of bits of cloth saturated with the wash and laid on the surface. The sediment is allowed to remain on the skin. After the wash has been thus applied for some minutes, oxide of zinc ointment is applied gently with the finger before the surface has had time to dry; and this treatment is repeated at intervals of a few hours. As a rule the itching and burning is relieved at once, and occasionally the disease is arrested in its course. I have often found the following lotion useful; it is to be applied on cloths:—

℞. Liquor plumbi subacetat. dil., Oss.
Glycerinæ, f℥ss. M.

When there is a good deal of inflammatory action, and when the skin is thickened and more or less doughy or œdematous, I am in the habit of employing bread poultices made of the bread-crumb mixed with ice-cold lead-water. The sedative effect of this application is sometimes very grateful. The following lotion is highly recommended in some cases:—

℞. Pulv. calaminis, ℥j.
Glycerinæ, fʒij.
Pulv. zinci oxidi, ℥ss.
Aquæ, f℥vj. M.

It should be applied frequently by means of a sponge, the sediment being allowed to remain on the surface.

A very good remedy in my experience is the following:—

℞. Extracti grindeliæ robustæ fluid., f℥iv.
Aquæ ad Oj. M.

This is preferably applied on cloths which are permitted to remain in contact with the surface until nearly or quite dry before removal. When itching is a severe and prominent symptom, applications of hot water, or of cloths wrung out of the same and applied in quick succession as hot as may be borne to the affected skin, often allay this exasperating symptom when all else fails. Carbolic acid, which is one of the most efficient antipruritics, can rarely be employed in the acuter stages of eczema, but now and then when burning is less prominent as a symptom, and when itching is most tormenting, it is of use. I often combine it as follows:—

℞. Acidi carbolici, fʒij.
Glycerinæ, f℥j.
Lotio nigræ ad Oj. M.

I find that the erythematous form of eczema, when the skin is yet unbroken, and when there is at the same time more or less inflammatory infiltration, is that in which carbolic acid is most likely to agree. It must be applied with caution, however, in the acute stage of eczema, until it is found to agree with the individual case under treatment.

In a certain number of cases ointments appear to agree better and to be more efficient than lotions. The oxide of zinc ointment, that much lauded and over-used remedy, here often finds its legitimate use, either alone or in combination with other applications. It should not be benzoated, or if benzoin be used, it should be used in small quantity. Bulkley recommends that this ointment should be used in varied strengths, from half a drachm to a drachm to the ounce of cold cream. The latter, the *ung. aquæ rosæ* of the Pharmacopœia, is, as Bulkley says, an admirable basis for many ointments which are ordinarily made up with lard. Being free from animal fat, it is not so likely to decompose; and the ointments thus mixed are more permanent than they would otherwise be.

Oleate of zinc, originally, I believe, brought into notice by Crocker, of London,[1] enters into the composition of a number of ointments which are very valuable in the treatment of acute eczema. It is made as follows: Take one part of oxide of zinc, and eight parts of oleic acid; stir together; allow to stand two hours; heat until dissolved. On cooling, a yellowish-white hard mass results, which may be variously made into an ointment. The following is one formula:—

℞. Zinci oleat.,
Ol. olivæ, āā ʒiv. M.

Or it may be made up with cold cream:—

℞. Zinci oleat., ʒij.
Ung. aquæ rosæ, ʒij.
Ol. amygdalæ, q. s. M.

The oleate of bismuth is a remedy sometimes employed with advantage, and I have found the following formula, highly lauded by Dr. McCall Anderson, of Glasgow, to be one of the most soothing of all the ointments which can be employed in acute eczema. It is in addition, when prepared with skill, a most elegant pharmaceutical preparation:—

℞. Bismuthi oxidi, ʒj.
Acidi oleici, ℥j.
Ceræ albæ, ʒiij.
Vaselini, ʒix.
Ol. rosæ, ♏ij. M.

Sub-nitrate of bismuth is highly recommended by most authorities, and for that reason I give it a place here, although I have no personal experience of its effects. The following formula is suggested by Duhring:—

℞. Bismuthi subnitratis, ʒss.
Adipis benzoati, ℥j. M.

When a soft ointment is required, half a drachm of glycerine may be often added with advantage.

Diachylon ointment, made according to the formula of Hebra, is a very useful preparation. It is usually more effective when spread upon cloths than when simply rubbed in with the finger. I usually bid the patient cut out bits of soft linen cloth to fit the part to be covered, and then to spread the ointment upon these as thick as butter upon bread. When applied they should be covered with oiled silk or waxed paper for cleanliness' sake. The ointment is composed as follows:—

℞. Olei olivæ opt., f℥xv.
Lithargyri, ℥iij. ʒvj.
Aquæ, q. s.
Coque. M. Ft. unguent.[1]

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[1] British Med. Journ., Oct. 26, 1878.

[1] The following directions are taken from Duhring (loc. citat., p. 186, note):—

"The oil is to be mixed with a pint of water, and heated by means of a steam-bath to boiling, the finely-powdered litharge being sifted in and stirred continually; the boiling is to be kept up until the minute particles of litharge have entirely disappeared. During the cooking process a few ounces more of water are to be added from time to time, so that when completed water still remains in the vessel. The mixture is to be stirred until cool. The ointment is difficult to prepare, and requires skilful manipulation. When properly made it should be of a light yellowish color, and of the consistence of butter. To ensure a good article it is essential that the very best olive oil and the finest litharge be employed." To this I may add that the physician should examine each lot as made up when this is possible, and he should in all cases decline to employ any ointment which has been on hand over a week. Although one of the most perfectly soothing and sedative of all ointments, unguentum diachylon is probably more apt to be ill made or decomposed when dispensed than any other, and it behooves the physician to look carefully after his prescription if he desires to avoid a possible catastrophe to his reputation.

A similar ointment may be made by adding two or three parts of olive oil to four of diachylon plaster, the two substances being melted together and stirred until cool. The proportion of oil used will of course vary with the weather. I do not often use this preparation, as it is apt to be tough and stringy. It is what the average apothecary dispenses, however, when unguentum diachyli is prescribed.

Among other soothing dressings may be mentioned finally, cold cream, cucumber ointment, glycerole of starch, olive and almond oils, and dilute glycerine. I may here remark that while glycerine in full strength disagrees with many skins, yet when diluted with one to three parts of water it will almost invariably be found to agree.

In papular eczema, the eruption being more discrete and scattered, the applications to be made must differ somewhat in form from those employed in vesicular eczema. Lotions are usually preferable, and in many cases where the individual lesions are widely separated these alone are admissible. Then, too, the inflammation is of a different character, and pursues, as a rule, a more chronic course. Soothing applications, therefore, do not often come into play, and we are more apt to have recourse to stimulant remedies, as the so-called anti-pruritics, and chiefly tar and its derivatives. Carbolic acid is the most important and generally useful of these remedies, and the one most apt to do good in papular eczema. The formula already given will be found suitable for many cases, only substituting water for the lotio nigra, and increasing the proportion of carbolic acid when the skin will bear it.[1]

A further account of the treatment requisite in acute eczema will be found under the head of the treatment of eczema attacking particular regions of the body.

Chronic eczema.—In some cases the treatment employed in the acute stage of eczema may also be made use of in the chronic condition of the affection; more frequently, however, other and more stimulating remedies will be found more serviceable.

Carbolic acid may be employed either in the form of a lotion, as above, or as an ointment of the strength of five to twenty grains to the ounce of oxide of zinc ointment, benzoated lard, or vaseline. It may be relied upon as an anti-pruritic remedy when all others fail, and is a most valuable application in chronic eczema. Thymol, recommended by Crocker,[1] in the form of an ointment or lotion, in the strength of from five to twenty grains to the ounce, is recommended by some writers; I have had very little experience with it. Tar and its preparations come largely into play in the treatment of chronic eczema. The tarry preparations must be handled with care, however, for if used injudiciously or in too great strength, they are apt to inflame the skin and retard the process of cure. They are most apt to be useful when the disease has completely reached the chronic stage and when there is more or less infiltration. In using tar in the form of ointment, which is ordinarily the most convenient method of employing this remedy, its strength should at first rarely exceed one to two drachms to the ounce. It can be increased later if the skin requires and will bear increased stimulation. The two forms of tar commonly employed are the pix liquida of the pharmacopœia and the oleum cadini. Their effect upon the skin is apparently identical. A very convenient formula is the following:—

℞. Olei cadini, fʒss.
Ung. aquæ rosæ, ℥j. M.

On the scalp fluid preparations are usually more convenient than ointments; the following formula is recommended by Duhring:—

℞. Picis liquidæ, fʒj.
Glycerinæ, fʒj.
Alcoholis, fʒvj.
Ol. amygdal. amaræ, gtt. xv. M.

I often use the oil of cade, mixed with three or four parts of alcohol, or of oil of almonds, as an application in squamous eczema of the scalp. These preparations are not to be smeared on the surface, or applied on cloths, as the soothing remedies. Much of their efficacy depends upon their proper and thorough application—they must be worked into the skin in order to produce their full effect; patients and attendants should be especially instructed on this point. In thick old patches of chronic disease, equal parts of alcohol, sapo viridis, and pix liquida may be applied in the same manner as the preparations above described. To produce a stronger impression potassa caustica may be used in place of the soap, in the proportion of five to fifteen grains to each ounce of the mixture. The following preparation, known as "liquor picis alkalinus," was introduced to the notice of the profession by Dr. Bulkley :—

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[1] An admirable description of the various uses of tar and its derivatives, will be found in an article by Dr. Bulkley entitled, "The local use of tar and its derivatives, including carbolic acid, in the treatment of skin-diseases," in Brown-Séquard's Archives of Scientific and Practical Medicine, April, 1873.

[1] Brit. Med. Jour., Feb. 16, 1878.

R. Picis liquidæ, f℥ij.
Potassæ causticæ, ʒj.
Aquæ destillatæ, f℥v. M.

The potassa is to be dissolved in the water, and gradually added to the tar, with rubbing in a mortar. Of course, this preparation is much too strong to be used undiluted except in the rarest cases. As a lotion it may be diluted with from eight or more parts of water, at first, down to two parts after a little trial; care should be used not to make the lotion too strong at first. The liquor picis alkalinus may also be combined with ointment, from one to two drachms to the ounce.

Soaps play an important part in the treatment of some forms of eczema. In ordinary cases, plain white Castile soap is all that is required for cleansing purposes; and the less soap that is used beyond what is necessary for this purpose the better, as a general thing. Strong alkaline soaps are used in eczema for their remedial effect, being particularly employed when some infiltration is to be removed, or when a stubborn and rebellious local patch of disease requires strong stimulation. Of these, the more generally useful is that known as Hebra's soap, sapo viridis, or green soap, a soap composed of potassa with herring or other oil,[1] and containing a certain amount of free alkali. It may be employed alone or in the form of an alcoholic solution, known as "spiritus saponis kalinus :"—

℞. Saponis viridis, pts. ij.
Alcoholis, pt. j.
Dissolve with the aid of heat and filter.

It may be scented with lavender or other perfume if desired. This wash is very useful also for cleansing patches of eczema from the accumulated crusts and scales.

Under ordinary circumstances, and unless left in contact with the skin with a particular object in view, these stronger soaps should be washed off at once, and some oleaginous or fatty substance applied. Much mischief is sometimes done by allowing caustic soaps to remain in contact with the skin. Some years ago, when sapo viridis first came into vogue, I saw case after case in which this alkali had been applied without knowledge or thought of its properties, as if it had been an ointment, that is, smeared on the inflamed skin and allowed to remain, to the great detriment of the patient.

Sapo viridis is particularly useful in extensive infiltrated eczema rubrum of the leg and other parts. It should be well rubbed into the affected patches, by means of a flannel rag, until considerable smarting, abundant serous discharge, and perhaps a slight bleeding, are induced. The soap is then to be completely washed off with pure hot water, the patch of disease lightly dried with a soft cloth, and some soothing ointment, by far most preferably unguentum diachyli, is applied, spread upon strips of cloth. This process is repeated once or sometimes even twice daily, and, when it can be properly carried out, is a rapid and efficient method of dealing with this form of eczema.[1] In old infiltrated patches of eczema, and in eczema palmarum particularly, solutions of caustic potassa, of the strength of ten to forty grains, or even a drachm to the ounce, may be employed to advantage. The stronger of these must be used by the physician himself, and may not be safely entrusted to the patient or his attendants. The application should be made with a little mop tied to a stick, or occasionally with a bit of wood. The parts should be immediately bathed with cold water, or covered with cold-water compresses, and after a short time a soothing ointment may be applied. This procedure reduces infiltration, and stops itching very effectually, but it is a sharp weapon, and not to be used rashly. Pushed too far there is danger of causing local sloughing with subsequent scars. It should not be used more than once or twice a week under ordinary circumstances.

Other remedies for the chronic forms and stages of eczema may be mentioned as follows: Mercurial preparations are particularly valuable, especially when the disease is confined to a small area. When covering a considerable surface mercurials should be used with care, or not at all, both on account of the fear of over-stimulation and that of absorption with salivation. Calomel is the most generally useful of the mercurial preparations; it may be employed according to the following formula :—

℞. Hydrarg. chlor. mite, ℈j ad ʒj.
Ung. zinci oxidi, seu ung. aq. rosæ, ℥j. M.

The red oxide of mercury, in ointment, from five to thirty grains to the ounce, is also often very useful; it forms a prominent ingredient, I believe, in some of the best known quack "tetter" ointments. Somewhat milder is the ointment of ammoniated mercury, which may be employed of the same proportionate strength with advantage in the pustular eczemata of children. Sulphur at times acts beneficially, but I rarely have recourse to it. Boracic and salicylic acids have also been highly recommended by authors of repute during the last few years; my experience with the latter has not been extensive, and I have been led to believe them of no great value.

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[1] Many imitations of this soap are found in the stores, which are usually inferior to the original article, which is made only by Duvernois, Stuttgart, Germany, and is imported into this country by some of our pharmaceutists.

[1] For a carefully detailed description of the *technik* of this procedure, see Duhring's Treatise, p. 190. I have not thought it advisable to go into the minutiæ of the plan here, because it can rarely be carried out satisfactorily excepting in an hospital, or where faithful attendants can be employed.

A few years ago, Mr. Squire, of London,[1] brought forward the preparation known as glycerole of the subacetate of lead as a remedy in chronic eczema. His formula is as follows: Acetate of lead, 5 parts; litharge, 3½ parts; glycerine, 20 parts by weight. Mix, and expose to a temperature of 350° F., and filter through a hot water funnel. The clear viscid fluid resultant contains 129 grains of the subacetate of lead to the ounce. This is used as a stock from which the preparations employed are made by dilution with simple glycerine. I have used this preparation quite extensively in the treatment of chronic eczema rubrum of the legs, particularly when the disease is extensive, of a dusky red hue, accompanied with weeping œdema and in varicose conditions; also in eczema of the palms and soles. In eczema of the legs I ordinarily use the glycerole stock diluted with three parts of pure glycerine. Strips of linen soaked in this fluid are applied to the affected limb and covered with waxed paper and a bandage, the dressing being changed once or sometimes twice daily. This method of treatment may be employed to advantage in many cases when the treatment by means of sapo viridis and unguentum diachyli cannot be carried out.[2] In eczema palmarum and plantarum I commonly employ an ointment employed as follows:—

℞. Glycerol. plumbi sub-acetatis, fʒss.
Glycerinæ, fʒiss.
Ung. aquæ rosæ, ℥j.
Ceræ albæ, q. s. M.

This is to be made into a tolerably firm ointment, and applied to the affected parts. It is better to precede its use with the application of solutions of caustic potassa, and it should be spread thickly upon narrow strips of linen and placed in close apposition to the affected parts, being covered with waxed paper to prevent soiling.

For obstinate circumscribed patches blistering with cantharides will be found serviceable. With the same object strong solutions of carbolic acid in alcohol, tincture of iodine, and solutions of nitrate of silver, or even the solid stick, may be employed. Vulcanized India-rubber has been used extensively in the treatment of eczema; and may be employed with advantage both as a protective against atmospheric influences, as a preparative for other applications, and as a direct therapeutic agent. In the form of Martin's solid rubber bandage it is of great use in varicose eczema rubrum of the leg. It is apt to give rise to great itching when applied upon the lower limbs. I therefore usually direct the bandage to be applied in the morning on rising, and to be worn during the day only. On retiring at night the bandage is to be removed, and the limb plunged quickly into water as hot as can be borne. Removed from this in a few moments, it is wiped gently dry, and the surface dusted with starch powder, and loosely covered with linen cloth for the night. If the itching is very severe, a carbolic acid lotion may be substituted for the powder. Under this treatment rapid amelioration is usually gained; and sometimes no further treatment is required. Rubber cloth in sheets, rubber masks, and finger-stalls are also often employed in the various forms of eczema with advantage.

Following the plan pursued by recent writers, I shall now proceed to give a brief account of the diagnosis and treatment of the local varieties of eczema, believing that it will materially aid in the management of the affection if it is contemplated from this point of view. Universal eczema is very rare; when it does occur it is usually erythematous or vesicular. Its history in these cases will serve to bring out one or another of the points mentioned in discussing the general diagnosis of the disease, and so lead to its identification. Eczema of the scalp, *eczema capitis*, is usually erythematous, vesicular, or pustular. The first variety rapidly runs into the squamous, the scalp being more or less covered with red scaly patches which are very itchy. The pustular variety is common among children. The pustules commonly come out in great numbers about the hair-follicles. They soon rupture, and the liquid oozing over the skin forms yellowish-green crusts, sometimes amounting to thick masses. The hair becomes matted and caked; the scalp if not cleansed gives out a very offensive odor, and the disease, unless checked by proper treatment, may last from a few weeks, even to years. The itching is usually not so decided in this as in other forms of eczema. Sympathetic enlargement of the subcutaneous lymphatic glands about the back of the neck and behind the ears, is common in this form of eczema, and in the case of children often gives rise to great anxiety on the part of parents. The glands never suppurate, and the patient's friends may be assured with confidence that as the irritation and inflammation about the scalp subside, the glandular engorgement will spontaneously disappear. Small abscesses often complicate the eczema of the scalp in unhealthy children. Pediculi, also, are very frequently present, and the scalp should be examined for the insects or their nits in all cases of pustular eczema. A patch of pustular eczema occurring in the occipital region, especially in neglected and ill-nourished children, almost invariably points to the presence of pediculi as a cause. When present they should at once be removed by the means mentioned under pediculosis.

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[1] Med. Times and Gaz., March 18 and 25, 1876.

[2] See a contribution to the subject, with cases, by Prof. Duhring and myself, Phila. Med. Times, Aug. 3, 1878.

Eczema capitis may be confounded with psoriasis, seborrhœa, favus, syphilis, and tinea tonsurans. From psoriasis of the head eczema may be distinguished by the symptoms mentioned in the general diagnosis of the disease. Seborrhœa sometimes resembles eczema capitis very closely. The oily character of the seborrhœic eruption, its diffusion, and the history of the case, are elements of importance. Other points have been touched upon earlier. Pustular eczema alone is likely to be mistaken for favus. But the mustard or canary color of the favus crusts, their commonly cup-shaped arrangement, and the dry pulverulent consistence of the masses of fungus, together with the microscopic appearance, will be sufficient to distinguish it from eczema. As before mentioned, certain syphilitic diseases of the scalp may be mistaken for eczema. The history of the case with the characteristic symptoms above given are ordinarily sufficiently distinctive. Erythematous, or squamous eczema may sometimes be mistaken for tinea tonsurans. The patches of eczema, however, are not attended with loss of hair. In tinea tonsurans the hairs are broken off uniformly about an eighth or a quarter of an inch beyond the scalp. The hair has a nibbled appearance. The patches in tinea tonsurans are apt to be roundish in outline. In eczema they are irregular. The color of the scalp is of a leaden hue; while in eczema it is reddish, and has more the appearance of inflammation. The itching in eczema is marked. In tinea tonsurans it is slight. A history of contagion is frequently found in connection with tinea tonsurans.

The treatment of eczema capitis will, of course, depend upon the variety and stage of the affection in each case. In pustular eczema, the crusts must first be removed by means of hot water and soap, preceded if necessary, by thorough saturation with olive or almond oil, to soften and loosen the crusts. Sometimes the scalp must be well saturated with oil, and covered with a cap over night; and perhaps the process must be repeated: at all events, the crusts must be removed before any applications are made. Occasionally the oil alone appears to exert a curative influence, but usually, more decidedly medicinal applications are required. The hair in children, boys, and men, may be cut short, especially when pediculi are present. In women, this is not necessary, and should not be permitted. I have sometimes seen a fine head of hair in a woman sacrificed on account of some comparatively trifling eruption of the scalp, which would have yielded quickly to appropriate local treatment, and this could easily have been employed while the hair remained. Now and then, however, we meet cases where women are suffering with severe and neglected pediculosis of long standing, and where the hairs are so matted and glued together, that we are obliged to have recourse to the scissors.

As to medicinal applications: in inflammatory cases, black wash, or one of the carbolic acid lotions may be applied with a sponge or cloth for ten or fifteen minutes at a time, morning and evening, and these may be followed each time by an oily preparation. If ointments can be used, the following is of value:—

℞. Hydrarg. chlor. mitis, ʒss ad ʒj.
Ung. petrolei, seu ung. aquæ rosæ, ʒj.
M.

A small portion only should be applied at once, but this should be rubbed in thoroughly. The ammoniated mercury ointment, ten to thirty grains to the ounce, and an ointment composed of ten grains of the red oxide to the ounce of vaseline, are both useful where stimulant applications are desired. The former is particularly valuable when the eczema depends upon the presence of lice, as it is also an efficient parasiticide.

When still stronger stimulation is required, especially in the chronic scaly variety of eczema, the tarry preparations are often of decided value. These should usually be employed in a liquid form, tar ointments being admissible only when the hair is very short; the following is an admirable application.

℞. Ol. cadini, f℥ss ad f℥j.
Ol. amygdalæ, f℥j. M.

Alcohol may be substituted for the almond oil, especially if the hair is quite thick.

Eczema faciei is more apt to be met with in children, but is also found in adults on the cheeks and elsewhere. The form of eczema found here is usually the vesicular or pustular. Soothing applications, as black-wash, followed by one of the milder ointments, should be used at first, and then if itching is severe, preparations containing carbolic acid and tar. It must not be forgotten in the case of children that the integument is tender, and consequently all stimulating applications are to be made in weaker preparations and with due precaution. Ointments of the oleate of bismuth, as the admirable preparation of Dr. McCall Anderson (p. 730), are very useful in the inflammatory eczema vesiculosum of children.[1] In adults the erythematous variety of eczema is that which is most commonly met with, and this is often a severe and intractable affection in that form. The various lotions described above are here more useful than the ointments.[2]

Eczema of the lips is ordinarily accompanied by swelling, redness, heat, infiltration, slight scaliness, and fissures. The muco-cutaneous surface or the skin outside may be attacked, and the symptoms and treatment differ according to the seat of the eczema. Eczema of the lips is to be distinguished from herpes and syphilis. Herpes runs a distinct, short course, and is composed of discrete well-marked vesicles or groups of vesicles. Eczema is more obstinate, and covers a larger surface. Syphilis occurring about the mouth usually either assumes the form of circumscribed, more or less irregular, erosions on the inside of the lip, or else is seen localized in the angles of the mouth, forming a more or less deep fissure and secreting a puriform fluid. Eczema of the lips, especially when occurring on the muco-cutaneous surface, is difficult and painful to treat. Solutions of potassa, nitrate of silver, carbolic acid, and alcohol may be used, care being taken to dry the surface thoroughly before they are applied, and to prevent the solutions running on to the sound surface. Sometimes mild applications are more useful than severe ones, and glycerine and water, oil of sweet almonds, vaseline, etc., may be tried.

Eczema of the eyelids often occurs in scrofulous and badly nourished children, and, less frequently, among adults also. The hair-follicles are involved, small pustules forming which dry into crusts, gluing the edges of the lids together. These are usually more or less red and swollen. Conjunctivitis may or may not be present. The treatment varies according to the severity of the case. Mild cases require no more than a weak nitrate or red oxide of mercury ointment, the former being the officinal ointment diluted with three to six parts of cold cream, and the latter being of the strength of ten grains to the ounce. In severe cases, Dr. McCall Anderson recommends that the eyelashes should be extracted, the edges of the lids carefully dried and then touched with a camel's-hair pencil moistened with a drop of solution of caustic potassa, ten grains to the ounce. This application is to be wiped away immediately and the effect neutralized by the application of dilute vinegar or acetic acid. The operation may be repeated every few days, and afterwards the edges of the lids may be smeared with dilute nitrate of mercury ointment.

When eczema attacks the beard it gives rise to great annoyance, and usually runs a very stubborn and chronic course. Pustules, usually seated about the hairs, form with great rapidity and persistence, and are followed by yellowish or greenish crusts, often matting the hairs together. Usually the affection is confined to a limited locality, as the corner of the upper lip, or the upper lip just at the nasal opening, but occasionally the whole beard may be involved and the disease may extend to other parts of the face. In this respect the affection differs from sycosis non-parasitica, which is always limited to the hair-follicles. The latter is also a deep process concerned with the follicles themselves; while eczema barbæ is essentially superficial, involving the surface of the skin and only taking in the hair follicles by the way as it were. Papules and tubercles, common in sycosis, are absent in eczema barbæ. The two affections do, however, very often resemble one another very closely.

Tinea sycosis is sometimes mistaken for eczema barbæ; it is important to distinguish between the two diseases. Crusts are generally abundant in eczema, in tinea sycosis they are generally (not always) scanty. When the crusts are removed the eczematous surface is smooth, while in tinea sycosis it is rough, uneven, tubercular, and lumpy—a very important point. The hairs in eczema are usually firm in their follicles, and cause pain when they are pulled, even when there is a good deal of suppuration about the root. Under the microscope they are seen to be straight and surrounded by the glutinous transparent root-sheath. In tinea sycosis, on the other hand, the hairs come away without the least pain or difficulty; they are often crooked, and are usually quite smooth and dry. Above all, they almost invariably contain the characteristic fungus (see tinea sycosis), and not infrequently the source of contagion, for tinea sycosis is highly contagious, may be traced, or the presence of a "ring-worm" somewhere else on the body demonstrated.

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[1] For fuller details regarding treatment, see Dr. Bulkley's paper on the Management of Infantile Eczema.

[2] There is a very fine representation of infantile eczema of the face of the impetiginous variety in Dr. Duhring's Atlas; also an illustration of erythematous eczema of the face in the adult. Both of these plates may be studied to great advantage for diagnosis, and the letter-press for the details of treatment.

Treatment must be prompt and energetic. The crusts must first be removed with oil or poultices followed by soap and warm water, and then the beard must be carefully shaved. This is a painful operation when first performed, and patients often rebel against it. It is well to be firm, however, and I usually decline entirely take charge of a case unless my directions in this respect are complied with. After the first time shaving is much less painful, and patients do not object. Ointments and applications can not be brought into intimate contact with the surface when there are hairs growing upon it. In the acute stage the sapo viridis and ung. diachyli treatment above described is the best. When the disease runs a chronic course, stimulating ointments may be used.

The ears may be attacked by eczema, either alone or in connection with other parts of the surface. All varieties of eczema may occur in this locality. In the acute forms and stages the ears are red and swollen, and they burn and itch acutely. The disease often involves the meatus, causing temporary deafness from occlusion by large and abundant epidermic flakes and scales. Ointments, as a rule, are most useful in eczema of the ears, and those containing calomel and tar are of service. When the meatus is involved, the canal should be syringed out and cleansed of all crusts and scales, oil of almonds being first used if necessary to soften the masses. Care must be taken not to injure the membrana tympani, especially when using the potassa solutions, which, as in the eczema of the eyelids, are found most useful, and which here also should be followed by the application of stimulating ointments. Eczema occurring about and especially within the ears is stubborn.

The genitalia are not infrequently attacked by eczema, which in this locality often gives rise to most distressing symptoms. In the male, the penis or the scrotum alone may be involved, or both together. The latter is more commonly the seat of the disease, and the tissues of the skin here frequently become greatly swollen, thickened, and infiltrated. Moisture, crusts, and painful fissures along the folds of the skin are often present. Itching is a severe and prominent symptom, and the disease is apt to be very chronic. In the female the labia and even the vagina may be invaded. The affection here is even more distressing than in the male. Itching is violent, and causes extreme misery. The diagnosis is not difficult. Pruritus alone is apt to be mistaken for eczema of the genitals, and here the absence of visible primary lesions will decide the character of the case.

Sometimes eczema of the genitalia yields quickly to treatment; oftener, however, it is obstinate to an extreme degree. The sapo viridis and unguentum diachyli treatment, when this can be carried out, is sometimes the best; at other times solutions of potassa, half a drachm or even a drachm to the ounce, may be used in place of the soap, care being taken to quickly mitigate their effects by means of water or dilute acids, and then to dress the parts with one of the more soothing ointments. When the disease is acute, dilute lead-water or black wash may be used, and occasionally dusting with a mild astringent powder. Carbolic-acid lotions are useful when there is considerable itching without excessive infiltration or fluid discharge. Stimulating ointments, mercurial, tarry, etc., may be employed, and one thing should be tried after another until relief is gained; for in this form of eczema more than any other, perhaps, the treatment must of necessity be largely empirical and tentative.

Sometimes the anus is attacked by eczema, either alone or in connection with the neighboring parts. The erythematous form is here most commonly met with; but sometimes deep and painful fissures form, and in this variety the disease is sometimes liable to be mistaken for syphilis. Other symptoms on the rest of the body, as well as the absence of itching, will serve to settle the diagnosis. The peculiar gray color of the mucous patch about the mucocutaneous surface is quite characteristic. Eczema with fissure of the anus gives rise to great pain on defecation, and, on account of this, constipation from over-retention of feces is commonly present, with the effect of heightening the discomfort and pain caused by the passage of the stools. Itching and burning sensations, worse at night on going to bed, and in severe cases pain on defecation—these are the chief symptoms of eczema ani. The treatment is in general the same as that suggested in eczema of the lips, but it may be added that strong tar ointments are apt to be most useful in average cases. The parts should be kept scrupulously clean, and the nates and perineum should be powdered with starch or astringent powders if there is any tendency to moisture in these parts. Aperients, by permitting the passage of the feces in a softened condition, and also possibly by relieving the circulation in the hemorrhoidal veins, may often be of service.[1]

Eczema intertrigo resembles erythema intertrigo, but shows the characteristics of eczema. The parts should be dusted frequently with astringent powders, kept from rubbing, if possible, by the interposition of lint or cloth, and rest, when possible, should be enjoined. Sometimes astringent lotions are useful.

The breasts in females are often the seat of a very troublesome eczema, brought about or kept up by nursing. The diagnosis, which, especially from syphilis, is very important, is to be made by exclusion. Eczema occurring in this locality shows the infiltration, redness, exudation, burning, itching, etc., characteristic of the affection. The sapo viridis and unguentum diachyli treatment, or that by solutions of potassa, is the best. The treatment should in every case be decided and vigorous.

Eczema of the umbilicus is usually moist and fissured. A disagreeable odor generally accompanies the affection in this locality, and there are scales and crusts. The disease is apt to be mistaken for syphilis if it occurs only in this locality, but in syphilis ulceration usually occurs, and the smell is more than disagreeable—it is positively offensive.

The legs are very often the seat of eczema, especially in old people. The erythematous and vesicular varieties are commonest at the beginning, but these soon change to eczema rubrum or eczema madidans. The affection occurs in one or more patches of various size; the whole leg being not infrequently involved. When it comes under notice, it has generally lasted some time, the skin of the leg is smooth, shiny, dusky-red, or violaceous, and unbroken; or it may be moist and weeping, or covered in part or wholly with scales and crusts. There is always a good deal of thickening and infiltration, with burning and itching to an extreme degree. Varicose veins often accompany this form of eczema, and varicose ulcers are not uncommon. Eczema rubrum sometimes occurs in elephantiasis Arabum of the legs; here it is secondary to the other affection. The diagnosis of eczema of the leg is not difficult. Ulcers, when present, are to be distinguished from syphilitic ulcers.

The treatment in eczema of the leg must vary with the nature of the case. In moist eczema the sapo viridis and unguentum diachyli treatment is one of the best when it can be carried out. Next to this is the treatment by means of glycerole of the subacetate of lead. Both forms of treatment have been already described. When enlarged or varicose veins are present, particular pains must be taken to support the vessels and to give tone to the circulation. The patient should sit or lie with the limb in an elevated position, and should never permit it to hang down. Walking exercise may sometimes be taken in moderation with benefit, if the limb has been supported by an elastic stocking, or by one of Martin's rubber bandages. Bandages of one kind or another should always be employed in eczema of the leg, both to support the dressings properly, and to give tone to the vessels, as has been said. Too much stress cannot be laid on the importance of attending to the condition of the circulation in eczema of the leg. The rubber bandage is particularly useful when there are ulcers present. It should be applied directly to the limb, care being taken to exercise firm and even, but not too severe, pressure. At night the bandage should be removed and dropped into a bucket of cold water, from which it can be removed in the morning and dried previous to reapplication. The leg should be dusted with starch, or dried with a towel; or it may be bathed with hot water or carbolic acid if there is much itching, and then is to be wrapped up loosely in a muslin bandage or cloth for the night.[1]

The backs and palms of the hands are frequently the seat of eczema, but the appearance and course of the disease is so different in one case from another that they must be considered separately. Eczema vesiculosum is the variety most common on the backs of the hands and on the backs and sides of the fingers. Sometimes the pustular variety is found, and occasionally fissured eczema, about the knuckles. The vesicular form of eczema is not unlike that found in other localities, excepting that large blebs occasionally form. It may be acute or chronic, and in some cases the nails are also involved in the disease. It is apt to occur as a result of exposure to acids, alkalies, brick-dust, etc. The diagnosis between scabies and eczema of the backs and sides of the fingers and of the backs of the hands is sometimes very difficult. In scabies the peculiar burrow of the itch insect, a short, irregularly curved, beaded black line of quarter of an inch in length, is often present, and the vesicles are few in number and scattered. In eczema, on the other hand, the vesicles are numerous and closely grouped. In scabies the vesicles are firm, and usually remain unruptured until they are opened by mechanical means. In eczema the vesicles usually rupture spontaneously at an early period. The vesicles of scabies commonly exhibit a fine, dark, irregular line made up of points through their summits, being the original burrow in the epidermis which has been raised by the formation of the vesicle. This is of course wanting in eczema. The occurrence of scabies elsewhere over the body will also assist in the diagnosis. Vesicular eczema of the backs of the hands may also be confounded with the rare disease known as dysidrosis or pompholyx.[1] Eczema of the backs of the hands, and particularly eczema of the fingers, is apt to be very intractable, sometimes recurring every year or oftener at regular intervals. Stimulating ointments commonly answer the best purpose. When the case is chronic, and not very extensive, the vesicles may be ruptured by an application of a solution of caustic potassa, twenty to forty grains to the ounce, applied with a pointed stick or brushed quickly over the surface and washed off. The application is to be followed by a soothing ointment. India-rubber finger-stalls and gloves are sometimes employed with success. Eczema of the backs of the feet differs in no essential from eczema of the hands. It is less frequent, however, and is apt to be much less extensive and rebellious to treatment.

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[1] See Bulkley, The Management of Eczema of the Anus and Genital Region, New York Medical Record, vol. ii., 1880, p. 676.

[1] For a full description of the rubber bandage, see an article by Dr. Bulkley, Archives of Dermatology, July, 1878.

Eczema of the palms and soles presents some peculiar features. Owing to the thickness of the epidermis in these localities, the appearance of the affection is somewhat marked. Infiltrating, thickening, more or less callosity, dryness, and fissuring mark the disease. It is very chronic and intractable. Sometimes deep and painful fissures occur, and when these are found upon the feet locomotion is rendered almost or quite impossible. The diagnosis of eczema of the palms and soles is as a rule difficult. It is apt to be confounded with psoriasis and syphilis. From psoriasis eczema differs in showing moist and bloody fissures, while those of psoriasis are usually dry, and show little disposition to bleed. The patches of eczema are usually larger than those of psoriasis, and their edges pass gradually into the healthy skin. The patches of psoriasis are smaller, darker, covered with more abundant, and paler or white scabs. But the best point in diagnosis is the appearance of the disease on other parts of the body. When the palms and soles alone are affected I think it is very often quite impossible to distinguish one of these affections from the other. The diagnosis between eczema and syphilis of the palms and soles is not so difficult, although sometimes when the affection is not found elsewhere one may be puzzled to come to a decision. The infiltration of syphilis is of a firmer nature than that of eczema; it also extends more deeply into the skin. The patches are smaller and more circumscribed, and sharply defined upon the edge, and they have a tendency to spread on the periphery and to assume the circinate form. Eczema is usually much more uniformly diffused, it is apt to be of a light color, and often itches, which syphilis does not. The history, and especially the recurrence of concomitant lesions elsewhere, will often aid the diagnosis.[1]

Eczema when it occurs upon the nails shows them deprived of polish, rough, uneven, and often punctate or honey-combed (psoriasis is often similarly punctate). The nail becomes depressed, particularly about the root, at which point its proper nutrition is arrested. It may gradually recover its normal condition, or it may be cast off and replaced by a new nail. With regard to treatment, tar-ointment, one drachm to the ounce, applied about the root, with the internal exhibition of arsenic, promise the best results.

HERPES.

Herpes is an acute inflammatory affection, consisting of one or of several groups of vesicles, occurring for the most part about the face and genitalia. Ordinarily it occurs without any accompanying general symptoms, but sometimes there is concomitant slight malaise and feverishness. It is often symptomatic, occurring in the course of a common "cold," or of digestive disorders, or in pneumonia, pleurisy, remittent and other fevers, etc. The lesions are commonly clustered, three or four together of the size of a pin-head to that of a small split pea, containing clear serum or sero-pus, situated on a somewhat inflamed base, and becoming quickly dried and covered with a yellowish crust.

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[1] See Duhring's Treatise on Diseases of the Skin, 2d ed., 1881, article, Dysidrosis.

[1] For a good description of the general principles of treatment in eczema of the hands and face, see Dr. Bulkley's paper, "On the Treatment of Eczema of the Hands and Face," read before the American Dermatological Association, Sept. 1, 1880, with the discussion thereon. Archives of Dermatology, vol. vii., 1881, Nos. 1 and 2.

There is usually a certain feeling of tension and burning with some itching. The affection runs an acute course, lasting a week or ten days. There are two regions, the face and genitalia, on which herpes is usually found, and from which the two varieties take their name. Herpes facialis is ordinarily seen in the form of the well-known "fever blister." It occurs on the lips, alæ of the nose, and more rarely elsewhere on the face and about the auricles. Herpes is also found on the mucous membrane of the oral cavity, forming those little shallow punched-out ulcers called "cankers." On the tonsils, where herpes is occasionally found, it is apt to be mistaken for diphtheria, especially if extensive and accompanied by enlargement of the tonsils and by febrile reaction. Sometimes this form attacks several members of the same family simultaneously. The characteristic discrete, punched-out ulcers resulting from an early rupture of the vesicles, serve to establish the diagnosis.

In herpes progenitalis[1] the vesicles are usually from four to six in number, varying in size from that of a pin's head to that of a split pea. They occur usually close together, and are apt to coalesce. The whole area covered by the group of lesions is not greater than that of a quarter-dollar. The parts usually affected are the sulcus of the glans, the reflected mucous membrane of the prepuce, and the shaft of the penis. The affection is so rare on the female genitals that its occurrence here is denied by some writers. The attention of the patient is called by slight itching and burning; a small red patch is observed, on which a crop of vesicles, at first clear, but soon becoming purulent, is observed. If situated on the mucous membrane, the vesicle soon breaks down, so that the lesion which is in fact first noticed is a superficial erosion. Unless irritated, the lesions tend to heal within a week or two. The tendency to relapse is very marked. Venereal diseases of a non-syphilitic character, as gonorrhœa and balanitis, seem to predispose to the occurrence of the affection, which, moreover, is often brought on by simple coitus, recurring after each act with exasperating invariableness. It is confined to the periods of youth and early manhood. Herpes progenitalis is apt to be mistaken for chancroid. In the earlier stages, indeed, the vesicles are identical in appearance in both diseases. The number and distribution of the lesions is a great help. The lesions of chancroid are not so numerous as those of herpes, and are not grouped together in the way the latter are. When multiple, the lesions of chancroid are the result of auto-inoculation, and are therefore of different ages. Time also shows the difference. After a few days the herpetic sore begins to get better, while the chancroid is getting worse. The syphilitic initial lesion need not often be confounded with the herpetic vesicle. It does not begin as a pustule; it is seldom multiple; is indurated at some time in its course; is accompanied by indurated glands, and does not appear as such until some days after the exposure. Eczema of the genitalia may resemble herpes, but the itching and generally severe and more extensive character of the eczematous disease serves to distinguish it.

The treatment of herpes faciei is very simple, a soothing ointment being usually all that is required. Herpes progenitalis usually requires very little treatment. Sometimes, however, various remedies are required. The best remedy for ordinary use is the dilute liq. plumbi sub-acetatis, applied on a soft piece of linen or absorbent cotton. Sometimes more stimulating applications are required. Powdered calomel sprinkled on the erosions morning and night, or equal parts of calomel and oxide of zinc, may be used. When the disease is prone to recur, astringent washes may be employed, as prophylactic. Circumcision is useful in inveterate cases, but even this has been known to fail.

HERPES ZOSTER.

Herpes zoster is an acute inflammatory disease, characterized by groups of vesicles situated upon inflamed bases, usually accompanied by more or less neuralgic pain. The neuralgic pain usually precedes the eruption, sometimes by several days. It is apt to be disproportionate to the amount of eruption. Occasionally it is entirely absent. The eruption makes its appearance in the form usually of an inflamed condition of the skin, attended with heat and burning sensations, and groups of discrete pin-head to split-pea-sized vesicles situated on a bright red surface appear over the region. The vesicles are often crowded together so as to coalesce, forming irregular patches. New vesicles continue to appear until the fourth to the eighth day, when the eruption is at its height; it remains this way a few days, and then begins to decrease, the vesicles shriveling, and by the tenth day or so, leaving brown crusts which drop off. The vesicles do not burst as do those of eczema. Ten days to three weeks is the average duration of an attack. The eruption does not always run a typical course. Only a few vesicles may appear, or they may abort before fully developing. On the other hand, they may suppurate and leave scars, though the disease commonly leaves no trace. The neuralgia varies from a very slight tingling to the most excruciating pain. Its amount bears no proportion to that of the eruption.[1] Herpes zoster may attack any part of the body, but is commonly found upon the trunk and head; less frequently upon the limbs. It follows very closely the course of the nerves, and the eruption is named according to the region upon which it occurs, as Zoster capitis, Z. faciei, Z. brachialis, etc. On the head it most frequently occurs in the course of the supra-orbital nerve, and it may affect the eye, giving rise to severe pain. On the head, both sides are sometimes affected; elsewhere the affection is almost always unilateral, so as to give rise to a popular superstition, that if the "shingles" (occurring on the trunk) should go all the way round the body, the patient would certainly die. The chest is the commonest seat for the occurrence of the eruption; and the names of the disease—zona, cingulum, a girdle, indicate this. Involving the intercostal nerves, the neuralgia often causes the affection to be taken for pleurisy until the eruption makes its appearance. When it occurs on the limbs the flexor surface is commonly attacked. It rarely occurs below the knee.

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[1] For a full account of this affection, see the admirable monograph of Dr. F. B Greenough, of Boston, on "Herpes Progenitalis," read before the American Dermatological Association, Sept. 1, 1880, with discussion. Archives of Dermatology, vol. ii., Jan., 1881.

The course of herpes zoster is acute, and, though somewhat variable as to duration, it tends to recovery.

Occasionally curious reflex symptoms are observed in connection with the appearance of the eruption. I recently saw a middle-aged man under the care of Dr. James H. Hutchinson, at the Pennsylvania Hospital, who was suffering with left lumbo-abdominal herpes zoster, in whom the slightest touch over the abdomen or over the upper lumbar vertebræ gave rise to marked convulsive muscular movements in the abdominal muscles and the flexor muscles of the thigh. At the height of the disease even the removal of the bedclothes or a breath of air upon the surface of the abdomen was sufficient to arouse the convulsive movements, but as the eruption dried and faded away the exalted reflex sensibility disappeared with it. The eruption in this case was fairly well-marked, but presented no unusual features. It was unaccompanied by neuralgia.

Herpes zoster rarely occurs twice in the same person. Now and then, however, cases are met with where it recurs year after year, perhaps six to nine times. Its etiology is obscure, but it is well recognized that the disease is dependent upon a peculiarly irritable or inflamed condition of the cutaneous nerve-trunks and branches.[1] Practically the disease consists in an inflammation of the spinal ganglia carried forward along the nerves to their termination upon the skin.

The diagnosis of well-developed, typical herpes zoster presents no difficulty. The neuralgic pain, the appearance of the vesicles in distinct groups, upon a highly inflammatory base, and the tendency to preserve their form intact, are characteristic. In eczema, which it most resembles, the lesions tend to exude moisture, dry and crust, while in herpes zoster there is no discharge. Eczema itches, zoster burns. From simple herpes, zoster is distinguished by the presence of pain, its nonrecurrence, its unilateral character, and by its rare occurrence upon the favorite seats of simple herpes, the lips, nose, and genitalia.

The treatment of herpes zoster is largely palliative. The disease runs a naturally favorable course tending to recovery, and the symptoms of neuralgia and burning in the seat of eruption alone require treatment. For the neuralgia I know of no remedy more efficient than the phosphide of zinc, in doses of one-third of a grain, given at the commencement of an attack, and repeated every three hours. If this fails in severe neuralgic cases, morphia may be given at night. Locally astringent powders, as those recommended in acute eczema, may be used. The subcutaneous injection of morphia in the line of the nerve-supply or elsewhere is advantageous when there is much neuralgic pain. In extensive cases bitter and ferruginous tonics are required. External treatment is usually of advantage. The parts should be protected from irritation and external influences. The vesicles should not be punctured, but left intact. Dusting-powders, similar to those recommended under acute eczema, should be freely sprinkled over the parts and covered with a piece of lint or Canton flannel, into the meshes of which the powder has been abundantly rubbed. Anodyne ointments and lotions often come into play. Collodion is an excellent protective; it prevents the rupture of the vesicles and exposure of a raw surface. Ten grains of morphia to the ounce of flexible collodion is a good preparation; it is to be painted on from time to time, so as to keep the eruption constantly coated.

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[1] A beautiful representation of the disease is seen in Plate R of Duhring's Atlas.

[1] See Picaud, Des éruptions cutanées consécutives aux lesions traumatiques, Paris, 1875; also Mitchell, Injuries of Nerves and their Consequences. Phila., 1872, p. 153.

Sometimes the galvanic current proves the most serviceable form of treatment. The constant current is to be applied directly to the seat of the eruption and over the course of the nerves by sponge electrodes. Five to ten cells may be used, and the application may be made once or twice a day. The prognosis of zoster is always favorable, the eruption running its course in a few weeks in almost all cases. Zoster of the orbital region, however, sometimes endangers the eye.

HERPES IRIS.

Herpes iris is an acute, inflammatory disease, characterized by one or more groups of variously-sized vesico-papules or vesicles, arranged in the form of concentric rings, attended, as a rule, by the display of varied colors. The patches vary in size from a small coin to several inches in diameter, and are made up of a number of usually rather indistinct vesico-papules or vesicles, which arrange themselves side by side, so as to form a perfect ring. It is a peculiarity of the disease that new vesicles are constantly forming on the periphery while the centre is healing up. When there are a number of independent patches they sometimes coalesce, and the interstices of the concentric and variegated circles present a picture so striking that it can never be forgotten. It looks sometimes as if the patient had been tattooed in rings of various colors, the prevailing tints being red, yellow, and brown. The backs of the hands and feet and the arms and legs are generally attacked, but sometimes the trunk is also involved, as in a very striking case shown me recently by Dr. Stellwagon, Physician to the Dispensary for Diseases of the Skin in Philadelphia. Here the patient, a boy, presented an almost rainbow-like play of colors in the interlacing and map-like rings of eruption, chiefly situated over the chest, abdomen, and back. The eruption is almost entirely unaccompanied by sensation of any kind. It tends to recur. It is a rare disorder, and is more apt to occur during the spring and autumn.

Herpes iris is closely related to erythema multiforme, above described. Duhring indeed considers the two affections as essentially different stages of the same disease. The diagnosis is not difficult; the appearance, locality attacked, period of the year, and absence of sensation, are all characteristic.

No treatment, as yet devised, appears to have any influence upon the disease. The affected parts should be kept free from the clothing and protected. Should excoriations occur, astringent and soothing powders or lotions may be employed. The prognosis is favorable; the disease runs its course rapidly, healing within a few weeks.

MILIARIA.

Miliaria is an acute inflammatory disorder of the sweat glands, characterized by numerous pin-point and millet-seed sized papules or vesicles, attended by pricking, tingling, and burning sensations. It may show itself as a papular or vesicular eruption, or both varieties may be present. The papular variety, known commonly as "prickly heat," begins with the formation of numerous exceedingly small, acuminated, bright-red papules, occurring in great numbers, and usually discrete, though often crowded together. The lesions are apt to come suddenly, and are usually preceded by considerable sweating. There are often numerous vesicles scattered among the papules. In place of papules vesicles may form, minute, acuminated, whitish or yellowish in form, very numerous, discrete and situated on a raised red base. The vesicles, with their contents, give the affected skin a yellowish tinge. There is apt to be more or less sweating. The seat of predilection is the trunk, but the face, arms, and lower extremities may also be attacked. The vesicles run an acute course, drying up in a day or two, and terminating in slight desquamation. The affection may either come to an end in a few days, or it may continue for some time, new crops of vesicles coming out in succession. It appears suddenly, developing in a few hours. It sometimes comes and goes. At times it is slight, at other times severe. The tingling, pricking, burning sensations, which accompany it, are at times very distressing.

The affection is brought on by excessive heat, and is apt to be aroused or kept up by too warm clothing, flannel underwear, bandages, and woollen shirts worn next the skin through the summer, etc. In hot climates the disease is much more serious than in temperate latitudes. Children and weakly or debilitated adults are particularly liable to the disease.

Miliaria, of both varieties, is simply an inflammatory disorder of the sweat-glands. Its tendency is toward vesiculation. No difficulty should arise in regard to the diagnosis of miliaria. The diseases most likely to be mistaken for it are eczema and sudamina. The symptoms of the former have been so fully detailed above that it is only necessary to allude to them. With regard to sudamina, it is to be remembered that the vesicles of this affection rise directly from the skin without inflammatory signs. When inflammation is present the affection is miliaria vesiculosa.

The treatment of miliaria is simple. The patient should be kept as cool as possible, and undue perspiration avoided. Cool baths and sponging, the use of lead-water or lotio nigra, dusting with astringent powders, and avoidance of warm clothing are to be recommended. Internally, refrigerant diuretics, as the citrate or acetate of potassium, are of use. The food should be light and unstimulating; wine and beer are to be avoided.

PEMPHIGUS.

Pemphigus is an acute or chronic inflammatory disease, characterized by the formation of a succession of irregularly-shaped blebs, varying in size from a pea to an egg. There are two varieties, pemphigus vulgaris, and pemphigus foliaceus. In pemphigus vulgaris the disease may attack any part of the body, but is commoner upon the limbs. It may also attack the mucous membrane of the mouth and vagina. The lesions are blebs from beginning to end, forming slowly or sometimes rapidly, in the course of a day. They may be few in number or quite numerous, and often vary greatly in size in the same case. They rise tensely stretched, like bladders of liquid, directly from the level of the skin, which is not usually reddened. They are clear at first, with serous contents, but later are opaque, containing pus. They do not rupture spontaneously, but gradually dry up, each bleb lasting one to three or six days. The lesions are apt to come in crops; they do not burn or itch to any marked degree, except in one rare form of the disease, known as *pemphigus pruriginosus*. In adults, there is little or no disturbance of the general system. In children the disease is apt to be accompanied by feverishness.

The affection may be acute or chronic, the former variety being rare excepting in children. In the adult the disease often lasts for years. Sometimes pemphigus takes on a malignant form; great numbers of large blebs form in rapid succession, coalesce, rupture, and are succeeded by excoriated surfaces, which sometimes take on ulcerative action. Sometimes blood is poured out and dries in thick crusts. This form of pemphigus appears often to depend upon bad hygienic surroundings. The prognosis is here unfavorable.

In pemphigus foliaceus the blebs are flaccid and only partly filled with fluid, which seems rather to undermine the epidermis than to lift it into blebs. The lesions often coalesce, involving a large part of the surface; fresh lesions are continually forming, the fluid dries into thin whitish flakes, which are cast off, leaving an excoriated red surface, and presenting the appearance of a superficial scald. The disease may last for years, and the patient finally succumb to exhaustion.[1]

Epidemics of pemphigus among children in asylums and elsewhere have been reported from time to time, but I am inclined to think with Duhring that these were in reality epidemics of impetigo contagiosa (q. v.).

Pemphigus is a rare disease in this country. It is more common in children than in adults. Poor food and bad hygiene, pregnancy, and menstrual disorders, mental depression, general debility, and prostration, are among the causes. The disease is not contagious.

The diagnosis of pemphigus is usually not difficult. The presence of blebs does not necessarily indicate pemphigus, as these are developed in other diseases and by artificial means.[2]. So called pemphigoid eruptions, obscure in origin and nature, are sometimes met with, but their course is not that of pemphigus, properly so called. *Impetigo herpetiformis* or *herpes impetiginiformis* is a disease closely allied to pemphigus, but separated from it by some peculiarities.[3] Pemphigus is not under any circumstances to be confounded with the bullous syphiloderm, formerly called "pemphigus syphiliticus." The only point in common is the presence of bullæ. But these, in the bullous syphiloderm, dry up into thick bulky greenish crusts, beneath which exists an excoriation or ulcer, secreting a greenish yellow product mingled with blood. The use of the term "syphilitic pemphigus" has led to much confusion of mind regarding the two diseases; now, fortunately, for the most part, a thing of the past. Herpes iris, and impetigo contagiosa, the latter as occurring in infants, may be mistaken for pemphigus; but the former may be distinguished by the very imperfect development of its vesicles, and by the concentric arrangement of the lesions, while the blebs of impetigo contagiosa are not well developed, are surrounded by an inflammatory areola, and dry up into somewhat thick crusts which often rub off, showing an excoriated and secreting surface. In addition, the contagious character of the lesions may almost always be made out.

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[1] A very interesting case (with photograph) has been reported by Dr. S. Sherwell, Archives of Dermatology, Jan., 1877; also by J. E. Graham, of Toronto, Canada Journ. Med. Sci., June, 1879.

[2] See a note in Duhring, p. 235, where a case of feigned pemphigus is described, the bullæ being produced by the application of nitric acid.

[3] Dr. C. Heitzmann, Archives of Dermatology, Jan., 1878, describes the relationship of the two diseases at some length.

The internal treatment of pemphigus is the most important. The history of the patient should be carefully examined into, the general health looked after, and any unfavorable circumstances obviated so far as possible. Functional disorders should be inquired into, and the various secretions regulated. The most valuable medicine is arsenic. This should be given in gradually increasing doses, beginning at two to four minims, thrice daily, in wine of iron or some other excipient, and increasing until the limit of tolerance is almost reached; care should be taken, however, not to upset the stomach. It must be remembered that arsenic is a medicine which produces its effects only slowly, and therefore this treatment should be persisted in, as indeed should all treatment in so chronic a disease as pemphigus often is, without expecting a rapid cure or even amelioration in the symptoms. Quinine is of value in the treatment of pemphigus, and Sherwell lauds linseed meal in ounce doses with milk, reporting two cases cured under this treatment. The diet should be full and substantial, and cod-liver oil may be added with benefit in some cases. Stimulants, as malt liquors and wine, may at times be recommended. Rest and freedom from toil, worry, and excitement, should be procured, and the patient made as comfortable as possible in body and mind. Local treatment is also of importance. The blebs should be punctured and evacuated as soon as they have formed. Soothing and astringent lotions, and especially dusting-powders, as that composed of equal parts of powdered oxide of zinc and starch, may be employed. Baths containing bran, starch or gelatine may be employed in some cases. Hebra has used the continuous bath, which consists in putting the patient in a specially constructed bath-tub and keeping him immersed for weeks and months, only emerging when absolutely necessary. Patients eat, drink, and sleep with comfort in such baths for long periods, and without injury to health; a hair mattress and pillows are placed in the tub, and the water is kept constantly warm and at an even temperature. It is sometimes the only means of relief. Occasionally water does not agree, and in these cases mild ointments, as that of oxide of zinc or diachylon, may be prescribed. Pemphigus runs an extremely uncertain course. Relapses frequently occur. When the blebs are numerous, flaccid, imperfectly formed, and inclined to rupture, and when they are rapidly and frequently formed, the prognosis is unfavorable. Repeated febrile attacks also indicate an unfavorable tendency. On the whole, then, we may say that the prognosis of pemphigus must be very guarded, as even when beginning as a slight attack an unfavorable turn may be taken and the case end fatally.

LICHEN RUBER.

Lichen ruber is an inflammatory disease, characterized by pin-head or pea-sized, flat and angular or acuminated, smooth and shining or scaly, deep-red, discrete or confluent papules, running a chronic course, and attended by more or less itching.

The acuminated form is rare. The angular form, lichen ruber planus, is that commonly met with, the papules varying in size from a pin-head to a split pea: often they coalesce and form patches. The shape of the papules is peculiar and characteristic; they are seldom round, as most papules, but are instead quadrangular or polygonal in form. They rise abruptly from the skin to the sixteenth of an inch or less, are flattened on the summit, and show a minute umbilication, with whitish puncta. To the touch they are firm, smooth, and without scales, except in those cases where the disease runs into a papulo-squamous stage. They are glazed and of a peculiar dusky crimson or even violaceous color. Usually discrete, the lesions are sometimes aggregated so as to form sheets of raised and infiltrated lesions.

The diffused form of the disease is rarely seen in this country. It is made up of large patches of acuminated lesions. Itching is generally present in both varieties of the disease. It is usually moderate, but may at times be severe.[1] The commonest locality of lichen ruber planus is on the forearms, especially upon the flexor surfaces of the wrists. It occurs also on the palms and soles, and on the penis. It is apt to be symmetrical, and the lesions are sometimes arranged in rows. The course of the disease is slow, months elapsing, according to Duhring, without there being any appreciable change in the lesions, while the process may last for years. My own experience, though limited, has been much more favorable as regards the duration of the disease. Persistent dark brown or violaceous stains succeed the lesions. The severer forms are said to run a graver course, and to sometimes end in marasmus and death.

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[1] A lecture by Dr. Duhring on that form of lichen ruber which occurs in sheets will be found in the Philadelphia Medical Times, April 27, 1878. A representation of the usual form of lichen ruber planus will be found in Tilbury Fox's Atlas of Skin Diseases, Plate 13, and Hebra's Atlas, Lieferung iii., Tafel 2, gives a picture of the diffuse form of the affection. A good account of the acuminated variety of lichen ruber is contained in the report of a case by Dr. White, of Boston, in the Hospital Gazette and Archives of Clinical Surgery, November, 1877.

The cause of lichen ruber is generally to be found in exhaustion, nervous debility and depression, overwork and improper diet, leading to an impoverished nutrition.

Lichen ruber may be mistaken for the papular syphiloderm, which it closely resembles, especially in the coppery or ham color of the lesions. In the plain variety, however, the peculiar shape and contour of the lesions, with their smooth umbilicated or punctate surface, will serve to distinguish them. Eczema papulosum, which often resembles lichen ruber, differs in that the papules are roundish, somewhat acuminated, bright red in color, and intensely itchy. Their evolution also is different.

The internal treatment of lichen ruber should be chiefly tonic and supporting. Arsenic is of high value, and is in fact almost a specific. The dose, at first small, should be increased and persisted in. Iron, cod-liver oil, etc., may be required. Hygienic measures and good food are important. Locally, simple ointments, as vaseline or cold cream, may be employed when itching is not present. When the eruption itches, alkaline baths, carbolic-acid washes or ointment, dilute hydrocyanic acid with water, diluted liquor picis alkalinus, or tar ointment. The following formula is a good one when a mild preparation of tar is required. It has the advantage of being rather more agreeable than most tar ointments:—

℞. Olei rusci crudi (vel. ol. betulæ), ʒj.
Ung. aquæ rosæ, ℥j.
Ol. rosæ, ♏xx. M.

In addition to these, the more stimulating and stronger anti-pruritic remedies, mentioned under the head of eczema, may be employed with the hope of reducing the pruritus and bringing about absorption of the lesions.

The prognosis of lichen ruber will depend upon the extent of the eruption, its duration, and the patient's general condition. Localized eruptions on the wrists and forearms, occurring in persons of average health, do not in my opinion require a very lengthened course of treatment. When, however, the eruption is extensive and severe, the prognosis is less favorable.

ACNE.

Acne is an inflammatory, usually chronic, disease of the sebaceous glands, characterized by the formation of papules, tubercles, or pustules, or a combination of these lesions, occurring for the most part about the face. It may appear alone or in connection with other affections of the sebaceous glands, as comedo and seborrhœa. The lesions are of various sizes, from a pin's head to a large split pea, and are commonly seen in both the papular and pustular, or the tubercular and pustular forms, combined. We may see the beginning of inflammation in a hair follicle, the pustule in its formative stage, and the fully-developed pustule appearing in the same individual simultaneously. The lesions are acutely inflammatory, but are not often accompanied by burning, itching, or in fact by any subjective symptoms, excepting occasionally a feeling of soreness when touched. Their color may vary from bright red to dusky or violaceous, with usually a pustular centre. The number of lesions varies greatly in different cases. There may be only one or two, or they may be very numerous. The inflammation may be superficial, or it may be deep, and even occasionally leading to the formation of abscesses. The individual lesions may run an acute course, passing through their various stages in a few days, or they may be very slow in their development and evolution; but the disease as a whole almost invariably runs a chronic course, the process frequently lasting for years. If there has been much suppuration, more or less unsightly scars may remain.

The chief seat of acne is upon the face, neck, shoulders, and chest, although it may occur upon any part of the surface excepting the palms and soles. The severity of the disease varies very greatly. In some instances it may be represented by one or two lesions only, while in others the face, neck, shoulders, and chest may be covered with unsightly papules, pustules, suppurating tubercles, and abscesses. Acne is one of the commonest diseases of the skin. It occurs in the young of both sexes, appearing usually about the age of puberty. It does not occur in children, and only rarely makes its appearance for the first time in mature years.

Several varieties of acne may be mentioned, which are named from the anatomical lesions displayed. *Papular acne* is most common upon the forehead. It consists in pin-head to small pea-sized papules, flat or more or less acuminated, lightish in color, situated about the sebaceous follicles, and often showing a minute black point which indicates the mouth of the sebaceous duct. This variety of acne, sometimes known as *acne punctata*, is often accompanied by comedones. The lesions, though commonly most plentiful over the forehead, are also frequently met with on the face and elsewhere. There are usually a few pustular lesions scattered here and there among the papules. The latter are not inflammatory, and papular acne is the least developed form of the disease.

Pustular acne is the typical form of the disease, though even where this is the prevalent character of the lesions in any given case, there may occur many which show intermediate stages of development. The pustules are pin-head to large pea-sized, rounded or acuminated, seated on a more or less infiltrated base of superficial or deep inflammatory product. Suppuration may be slight or abundant. When the base is deeply infiltrated the affection is known as *acne indurata*. Among the results of pustular acne may be mentioned pitting or atrophic cicatrization, which is of a permanent character, and keloid, which is a temporary hypertrophy, sometimes lasting however several months after the disappearance of all inflammatory action in the lesion.

Artificial acne is sometimes observed as the result of the external employment of tar and other substances. The so-called bromine and iodine acne will be found treated of under the head of medicinal eruptions.

The causes giving rise to acne are numerous and varied in their nature. In its commoner forms it appears to be dependent to some extent on the character of the skin. Persons with thick oily skins are more apt to suffer from acne than those whose skin is thin and dry. It occurs much more frequently in persons of light complexion. The most frequent cause of acne is puberty. The affection shows itself for the first time in the vast majority of cases at this period, and is apt to continue until the system has assumed the equilibrium of adult life. It is at this period that the sebaceous system takes on a new activity, the hairs begin to develop, and there is a sort of normal hyperæmia about the follicles, which may easily determine an abnormal condition resulting in the development of sebaceous disorders.

Other causes, which may either alone or combined give occasion to the occurrence of acne, are scrofula and cachexia or general debility. Anæmia and chlorosis may also be mentioned in close connection with these other causes as favoring the development of acne.

Of great importance in the causation of acne, and especially in favoring its continuance, is habitual derangement of the alimentary canal. Dyspepsia and constipation will be found present in the majority of cases, and often in such intimate relation to the disease that a fresh crop of lesions shall follow every attack of indigestion or of costiveness.

Uterine disorders, especially of a functional character, are often the direct cause of acne; but at other times the cause of the affection seems beyond finding out, the patient remaining in an apparently perfect condition of general health.

The diagnosis of well developed acne presents no difficulties. We often meet with cases, however, where only a few imperfectly developed lesions are present, and where the affection may easily be mistaken for others of a widely different character. The age of the patient, the seat of the lesions, their chronic character, and their inflammatory nature must be taken into account. The acneiform eruption caused by tar may be recognized usually by the smell of that substance, and its presence in the follicles giving the appearance of numerous black points. In the eruption caused by bromine and iodine the lesions are apt to be larger, of a brighter and more acutely inflammatory nature and, where well-developed, the lesions tend to coalesce and to form elevated inflammatory areas covered with characteristic sebaceous crusts. Acne often closely resembles the papular and pustular syphilodermata, and great care must often be taken to avoid mistakes in diagnosis. The history, the absence of syphilitic lesions on other parts of the body than those commonly affected by the eruption of acne, the uniform distribution of the lesions, those of syphilis tending to group, all serve to denote the presence of acne. When syphilis occurs on the forehead, or in one or two lesions on the nose alone, as I have sometimes seen it, without any history whatever, it is extremely apt to be taken for acne, and great caution must be exercised in coming to a decision as to the nature of the affection in a case seen for the first time. Severe cases of acne are sometimes taken for variola, but this can hardly occur if a careful examination is made into the general symptoms and history of the eruption.

The treatment of acne is of two sorts, constitutional and local. In order to treat a case of acne with any hope of success, we must first ascertain the causes which have operated in bringing it about. The foundation of the successful treatment of acne lies in the knowledge of its etiology. The patient should be carefully examined regarding every organ and every function. The habits of life, the surroundings, the occupation of the patient, should all be known to the physician, who should also study the case well to discover, if possible, what is the exact cause or group of causes of which the acne-eruption is the expression and the result. Without this, little can be hoped for, and acne is one of the minor *opprobria* of medicine, chiefly because the physician cannot or will not take the trouble to enter into the patient's case with the persevering thoroughness which is indispensable. It should be the aim of the physician to prevent the appearance of the lesions. External treatment will rarely accomplish this, and internal measures must therefore be employed in almost every case. From what has been said under the head of etiology it will be perceived that in general the patient's health must be looked after. If anæmic, tonics are required, among which iron and arsenic are prominent; if the uterine functions are not regularly performed, these must be regulated; if dyspepsia exists, this must be combated by diet, regimen, and the remedies appropriate to the condition. Constipation is a frequent concomitant with acne, and its removal is necessary to a cure. Acidity of the stomach, flatulence, a coated tongue, are ordinary symptoms, and these, together with irregular and perverted appetite, are constantly met with in the affection under consideration. If constipation exist, saline or vegetable laxatives should be prescribed in sufficient quantity to open the bowels once or twice in the day. An occasional mercurial, as blue pill, or a compound cathartic pill, may be prescribed in some cases. The admirable mixture of Mr. Startin, known as "mistura ferri acida," the formula for which has already been given (p. 727), is one of the most valuable tonic aperients which can be given for acne accompanied by constipation. It may be taken once a day before breakfast, or before supper as well in some cases. The natural mineral waters are used with good success in acne. The Hathorn and Geyser Springs of Saratoga, the German Friedrichshall, Hunyadi Janos, and Ofner Rakoczy waters, all cathartic, are of use, the dose of course varying with the amount of constipation present.

There are many cases of acne, however, which depend upon some general derangement of the system, the scrofulous taint, anæmia, etc., and these must be treated quite differently. Cod-liver oil, malt-extract, the bitter and ferruginous tonics, and alteratives are here called for. The mineral acids are often of value. A good form of iron is the tincture of the chloride given with phosphoric acid, as in the following:—

℞. Tinct. ferri chlor.,
Acid. phosphoric. dil., āā. ♏xv.
Syrupi limonis, fʒss. M.

Take thrice daily after meals in a wineglass of water.

Among alteratives, arsenic stands first, sometimes appearing to act almost as a specific in anæmic cases. It may be given at first in two to four minim doses, gradually increased until the limit of tolerance is reached, and then dropped a little below this and continued for a considerable period. The following formula is a favorite of mine; it combines the arsenic with iron:—

℞. Liq. potassii arsenit., fʒij.
Vini ferri, fʒiv. M.

Sig. Teaspoonful after meals.

Fowler's solution should never be given alone, to be taken in drops. This is a useless and not altogether safe method of administration. If it is desired to omit the iron, the arsenic may be given in cinnamon-water or, as I often give it, in water alone. I never give it unmixed. I may say here, that iron does not agree with some acne patients. As Dr. J. Milner Fothergill says, iron does not agree with "bilious" people. Instead of arsenic, mercury may be given. Dr. Taylor[1] prefers the following formula:—

℞. Hydrarg. bichloridi, gr. j.
Ammoniæ muriat., gr. vj.
Tinct. cinchonæ co., f℥iij.
Aquæ, f℥j. M.

Sig. One teaspoonful in a wineglass of water three times a day an hour after meals.

The dose here is the thirty-second of a grain, which may be increased every ten days until in general one-quarter of a grain is reached. The effect of this treatment begins in about two or three weeks. Of course it is not to be understood that syphilis is suspected in the cases in which mercury is recommended. It is simply as a tonic alterative. In cases where it may be desired to combine mercury and arsenic, Dr. Taylor recommends Dr. Valangin's solution (liquor arsenici chloridi) in the same dose as Fowler's solution.[2]

Dr. Duhring speaks well of sulphide of calcium, as recommended by Dr. Ringer, in the dose of one-tenth to one-half of a grain four times a day. I have not had much experience with this. It is most likely to be useful where the pustular lesions predominate. The sulphur mineral waters, as those of Richfield, Sharon, Avon, and the White Sulphur of Virginia, have a reputation for beneficial influence in acne; but I am inclined to believe that there is nothing specific in the effects of the waters themselves; and whatever good may be effected is gained by the pure air and general tonic effect of the surroundings. The influence of sulphur waters is generally upon the liver and intestines, and thus, indeed, they may be of indirect benefit in acne. Hygiene, in the shape of fresh air, exercise, cold bathing, and a sojourn in the country or by the sea-shore, will now and then effect what medicines may fail to do. It should be added that the sea-shore life occasionally is found to disagree violently with acne patients, bringing out the eruption in great abundance. Inquiry should be made before sending patients to the sea-shore, and they should be directed to change at once if the climate should prove unsuitable.

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[1] Loc citat, p. 9.

[2] Dr. Valangin's solution is made by dissolving half a drachm of arsenious acid in a fluidrachm and a half of hydrochloric acid, mixed with a fluidounce of distilled water, by the aid of heat. Distilled water is then added until the solution amounts to exactly one pint (imp. measure).

The local treatment of acne is important, and especially regarding the choice of remedies. There is perhaps no skin disease in which so many local applications have been at one time or another recommended. Used with discretion, a few will suffice, but the great number of formulæ extant serve only to confuse the practitioner in search of an appropriate topical application. The external treatment of acne may be soothing or stimulating. In rare cases there is much heat, redness, and acute inflammation present; and here mild washes and bland ointments will answer, such as those given under the treatment of eczema of the face. In most cases, however, stimulating applications are called for. Where the skin is rather coarse and sluggish, the face may be rubbed and washed every night with sapo viridis and hot water by means of a bit of flannel. The spiritus saponis kalinus (see p. 716) may likewise be of use. These are strong stimulant preparations; their chief use is to cause absorption when the lesions are sluggish and indurated; and they should be washed carefully off after use, and the part covered with powdered starch or a small quantity of cold cream or some other bland ointment. If they make the skin harsh, their use should be suspended or stopped. When the sebaceous gland-ducts are unhealthy and plugged up, and when comedones abound, the soapy applications, especially if combined with copious bathing with hot water, loosen and aid in pressing out the plugs of inspissated sebum, and in restoring the glands to a more healthy condition. The watch-key may also aid here in pressing out the comedones present (see under comedo, p. 717). Sulphur and its preparations are among the most valuable remedies in our possession for the treatment of acne in most of its forms. The following formulæ are given by Duhring, as among the most eligible ointments:—

℞. Sulphuris præcipitat., ʒj.
Glycerinæ, fʒss.
Adipis benzoat., ℥j.
Ol. rosæ, gtt. iij. M.

To this I may add another:—

℞. Sulphuris præcipitat., ʒj.
Pulveris camphoræ, ℈j.
Ung. aquæ rosæ, ℥j. M.

The following wash is given by Duhring, as having been suggested by Dr. Bulkley:—

℞. Sulphuris loti, ʒj.
Ætheris, fʒvj.
Alcoholis, f℥iiiss. M.
Sig. Shake the bottle and apply as a lotion.

I have myself also used this wash in a great number of cases with very great satisfaction. The following formula, known as Kummerfeld's lotion, may be given. I have frequently used it with success. It exercises a markedly astringent effect on the skin:—

℞. Sulphuris præcipitat., ʒiv.
Pulv. camphoræ, gr. xj.
Pulv. tragacanthæ, ℈j.
Aquæ calcis,
Aquæ rosæ, āā f℥iij. M.
Sig. Shake the bottle before using.

In the papular variety of acne, the following form is recommended by Duhring. I have used it also in the pustular variety with advantage:—

℞. Potassii sulphuret.,
Zinci sulphat., āā ʒj.
Aquæ rosæ, f℥iv. M.

The ingredients are each dissolved in one-half the water, forming clear solutions. They are then mixed, and a white precipitate takes place, which is to be shaken up and allowed to dry on the face.

Bichloride of mercury in the form of a lotion may occasionally be used to advantage. A convenient formula is the following:—

℞. Hydrarg. bichlor. corros., gr. ss.
Emuls. amygdalæ amar., f℥iv.
Tinct. benzoini, fʒss. M.
Sig. Apply at night.

The corrosive chloride of mercury constitutes the basis of the majority of the "lotions for the toilet" and cosmetics sold in the market.[1] Other and severer remedies for acne have been recommended by authors; but I have had little experience with them, and believe that in this country at least, the severer measures will usually prove too much for the skin, and will be more apt to prove injurious than beneficial.

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[1] Reference may be made to Duhring, op. cit., p. 259, for further information on this subject.

The prognosis of acne should always be guarded. While by no means the desperate and incurable malady which it is sometimes said to be by pessimistic or incapable practitioners, it yet often offers a stubborn resistance to treatment, and shows a marked tendency to relapse. The most extensively developed cases, moreover, are sometimes more amenable to treatment than those where half a dozen lesions alone represent the disease, and where the patient enjoys apparently good health. The question is in the long run one of time only, as a spontaneous cure sooner or later invariably occurs. If neglected, however, unsightly and disfiguring scars supervene in severe cases, and our efforts therefore should be unremitting to obtain a speedy cure if possible.

ACNE ROSACEA.

Acne rosacea is a chronic, hyperæmic, or inflammatory disease of the face, more particularly the nose, characterized by redness, dilatation and enlargement of the bloodvessels, hypertrophy, and more or less acne. The disease shows itself first by more or less hyperæmia of the part without swelling, and this may be intermittent, and noticeable only after exposure to a close atmosphere, or following the use of alcoholic stimulants or a full meal. The hyperæmia is of a passive character, and when in the nose is apt to be accompanied by seborrhœa, and the organ is cold to the touch. In the course of time the redness becomes more marked and is permanent. On close examination of the affected part the cutaneous vessels are seen to be dilated, enlarged and tortuous. Sooner or later, acne papules and pustules are apt to show themselves, as a rule, however, few in number. The affection may occur in all degrees, from a very slight, hardly perceptible blush, to a marked deformity. The face and nose are the parts usually attacked. The course of the disease is chronic, taking years for its full development. It begins at first as a simple dilatation of the vessels, and in many cases does not go beyond this stage, but in other cases hypertrophy supervenes, the tissues and glands of the skin become enlarged, and the parts seriously altered. The nose, in particular, may assume an hypertrophied, knobby, irregular aspect, and may grow to be enormously large, so that the Germans have called such noses *pfund-nase*, "pound-noses."[1]

The causes of acne rosacea are varied. It occurs in both men and women, but in the latter does not tend often to go beyond the first stages. In women, also, the disease is more prone to occur at two periods of life, at early womanhood and at the climacteric period. When occurring in young women, seborrhœa is apt to be present, and the disease appears to be due, in some measure certainly, to dyspepsia, anæmia, chlorosis, and menstrual difficulties. It usually goes away, but may return in later life. When it occurs later in life it is apt to be more severe. In men the disease may occur at any period. In early life it is generally due to anæmia and debility, nervous prostration, and dyspepsia. In later life the use of spirituous liquors is often the cause, and perhaps nearly as often, dyspepsia, in some one of its forms. Brandy, whiskey, and wines, taken habitually and in quantity, give rise to this condition in various regions of the face.

The treatment of acne rosacea depends upon the stage of the disease and upon its cause in the given case. Constitutional and local remedies are both used. The causes giving rise to the affection should be diligently sought for, and obviated when possible. Uterine and menstrual derangements are to be looked after, the stomach and bowels to be kept in good order, and all hygienic measures used to improve the general health. Alcoholic or malt liquors are to be totally eschewed. Tea and coffee should be drunk in moderation, and not strong. The food should be of the plainest character. The general medical treatment is that of acne. Local treatment however is of the most value. Sulphur lotions, as in acne, may be used in the early stages, the following formula being a useful one:—

℞. Sulphuris præcipitat., ʒj–iij.
Ung. aquæ rosæ, ℥j. M.

Sometimes sulphur lotions are more useful. The following will be found an efficient combination. It appears to exercise a decidedly astringent effect:—

℞. Sulphuris præcipitat., ʒj.
Pulv. camphoræ, gr. v.
Pulv. tragacanthæ, gr. x.
Aquæ calcis,
Aquæ rosæ, āā ℥j. M.

Corrosive sublimate may be used in the first stage with happy results, in the strength of one-fourth grain to two grains to the ounce of alcohol, or in ointment. Neumann and Hebra recommend mercurial plaster, spread upon cloths. Stronger applications are required in the second stage. The dilated capillaries may be incised with a sharp knife, in the hope that adhesive inflammation may result with the effect of closing the calibre of the vessels. Cold-water compresses are to be applied subsequently to control the bleeding, and a small number of vessels may be thus operated upon every day or two until the ground has been entirely gone over. Duhring has used with success ten- to twenty-grain solutions of caustic potassa, painted over the affected part once or twice weekly, and followed by an emollient poultice. In cases where there is but little thickening, carbolic acid, dissolved in three to four parts of alcohol, may be painted on the part every second day, as suggested by Neumann. Hardaway, of St. Louis,[1] recommends electrolysis. He uses a number thirteen cambric needle inserted into any convenient handle, and connected with the negative pole of a galvanic battery. A sponge-electrode is then connected with the positive pole. The needle is inserted sufficiently deep to enter the dilated vessel; so soon as this has been accomplished, the patient completes the circuit by taking the sponge-electrode in his hand. So soon as the electrolytic action has been properly developed, the patient releases the sponge-electrode, after which the operator withdraws the needle. Six to eight elements will generally suffice. If the vessel to be operated upon is a long one, several punctures must be made at suitable intervals of space. The needle may be inserted perpendicularly or parallel to the course of the vessel. Faradization has been recommended by Cheadle, of London.[2] In the later and severer stages ablation with the knife is the only remedy.

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[1] A remarkable case is figured in Drs. Maury and Duhring's Photographic Review of Medicine and Surgery, vol. ii., 1871–2. Another is in Hebra's Atlas. A good picture of the ordinary appearances presented in acne rosacea is that presented in Plate E, of Duhring's Atlas.

The prognosis in the early stages is favorable. When the disease has become thoroughly established, only thorough and long-continued treatment will avail. Beyond a certain point treatment is only palliative; it may prevent further progress, but this is much, and patients should be encouraged to persevere.

Sycosis Non-parasitica.

Sycosis non-parasitica is a chronic inflammatory, non-contagious disease involving the hair-follicles, characterized by pustules, papules, and tubercles perforated by hairs, accompanied with burning sensations. The disease is confined to the region of the beard and hair generally about the face. It begins by the formation of several or numerous papules or pustules surrounding the hairs. New lesions are generally added to these, and the eruption comes out in crops until it reaches its height. The pustules show no disposition to rupture; they remain discrete throughout their course, though sometimes so numerous as to be crowded together. They are accompanied by marked redness of the surrounding skin, sometimes by swelling; by sensations of a burning character, and at times by pain. If not attended to, crusts form and mat the beard together. Imperfectly-developed lesions are commonly associated with the fully-developed pustules. The disease may involve the whole face.[1] Unless suppuration is more than usually profuse, the hairs are extracted with difficulty and pain. The causes of the disease are not known. Shaving appears to be unconnected with its etiology, since it occurs equally among those who shave and those who do not. It is not contagious. The disease is essentially an inflammation of the hair-follicles. In the earlier stages the hairs are firmly seated in their follicles, but later, after free suppuration has been established, they are usually loose and may easily be extracted. If much suppuration occurs, the papilla of the hair may be destroyed, and permanent baldness may ensue.[2]

Non-parasitic sycosis is most likely to be mistaken for tinea sycosis. In both cases the hair-follicles are attacked, but in the parasitic disease the lesions are simply large rounded red lumps, or variously-sized nodules, with few or no pustules. The hairs, however, in spite of the fact that there is no suppuration about their root, come away easily and sometimes drop out spontaneously. The presence of the parasite when looked for in the nits of the diseased hairs under the microscope, will aid greatly in the diagnosis (see under the diagnosis of tinea sycosis). From eczema of the beard sycosis non-parasitica is distinguished by the absence of oozing or itching, and also by the fact that eczema rarely attacks the beard without showing itself elsewhere. In sycosis, also, each pustule is penetrated by a hair. Sometimes the acuminated pustular syphiloderm occurs in the beard, looking very much like non-parasitic sycosis, but lesions may always be found elsewhere which are characteristic.

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[1] Transactions of the American Dermatological Association; Archives of Dermatology, Oct., 1879.

[2] The Practitioner, July, 1874.

[1] See a typical instance in Duhring's Atlas, Plate H. I also had this patient under observation several years.

[2] For a very complete account of the pathology of the affection, see Dr. A. R. Robinson's paper entitled SYCOSIS: Prize Essay for 1877 of the Bellevue Hospital Medical College Alumni Association; New York Medical Journal, August and September, 1877.

External treatment is that most generally useful in sycosis non-parasitica. If any defect in the patient's health seems to call for internal measures, these are of course to be employed; but with the exception of Donovan's solution, which Tilbury Fox recommends when there is much induration, no specific internal medication is to be advised. Exposure to irritating influences is to be avoided, and clipping or shaving is to be practised. The latter is in my opinion much to be preferred. Although painful at first, I regard it as the *sine qua non* of successful treatment, and usually insist upon it in spite of the patient's protestations. In this, as in some other matters, *ce n'est que le premier pas qui coute;* and after shaving a few times the patient is brought to see the reasonableness of the procedure by the comfort which it brings. Shaving should be performed every second or third day, depending upon the rapidity with which the beard grows. When shaving is to be performed for the first time, the hairs should first be clipped close, and then a poultice should be applied to soften the crusts. Where there is much inflammation, this poultice may be made of bread-crumbs and dilute lead-water, and applied cold. This is very soothing. After such careful preparation, shaving is a much less painful operation than it would otherwise have been. When the disease is acute and there is swelling, it is to be treated as pustular eczema, by means of soothing lotions and ointments. If highly inflammatory, black wash may be applied several times through the day, followed by oxide of zinc ointment, with the addition of a drachm of alcohol or half a drachm of camphor to the ounce, spread upon cloths, and bound firmly to the part. The following formula is highly recommended by Bulkley :—

℞. Liq. plumbi sub-acetat. dil., ʒij.
Pulv. calamini præp.,
Pulv. zinci oxidi, āā ʒj.
Glycerinæ, ʒij.
Aquæ rosæ, f℥viiss. M.

The following ointment may likewise prove of service when the inflammation is not so acute and severe :—

℞. Hydrarg. chlor. mitis, gr. xv–xxx.
Ung. aquæ rosæ,
Ung. zinci oxid., āā ℥j. M.

On each occasion immediately after
shaving some soothing appl
at once be made. The f
ment is useful here :—

℞. Pulv. calaminis præc.
Pulv. zinci oxidi, āā
Ung. aquæ rosæ, ℥j.

Where the affection is of
and where there is much in
soap followed by unguen
may be employed. The p
be opened and the surface w
the soft soap, which is aft
pletely washed off with pu
which strips of muslin thick
diachylon are applied, and
bandage. When this trea
ployed the patient should sh
the applications should be
day. When, as in the maj
the affection is not extens
the inflammation is not a
stimulating plan of treatm
for; sulphur ointment, half
drachm to the ounce, or
mercury, fifteen to thirty
ounce, is often useful. Oi
trate of mercury, one to two
of cold cream, or oxide of m
fifteen grains to the ounce
may likewise be employed.
bichloride of mercury may
containing a quarter of a gr
to the ounce of water or alc

Sulphur lotions, as in ac
times employed with benefi
formula of mine is that was
camphor, and tragacanth gi
head of acne.

Some dermatologists rec
lation; the hairs, over a sm
extracted daily by means
forceps, and some soothing o
wards applied. The par
fomented with a hot poul
operation is undertaken.
think this procedure should
out where the hairs have
by suppuration. I would i
commend the painful, and,
most cases useless, practice
those hairs which are fir
their follicles. Few patien
stand the ordeal long. Sha
should be practised durin
course of the treatment, a
deed be continued for some
cure has been effected, in
the risk of a relapse.

The prognosis in sycosis
should be guarded, for whi
yield readily to treatment,
ticularly extensive cases, la
and even years in spite of th
ous attention. Relapses a
mon.

Impetigo.[1]

Impetigo is an acute inflammatory disease, characterized by one or more pea or finger-nail sized, discrete, rounded, and elevated, firm pustules, unattended, as a rule, by itching. The eruption is occasionally, but not often, attended by slight constitutional symptoms, as loss of appetite, constipation, and malaise. The pustules come out one or two at a time, and are discrete and scattered, never tending to coalesce. They are tense, raised, semi-globular, of a whitish-yellow color, and at first surrounded by an areola, but with little infiltration. In number they may vary from one to a dozen or more. They may occur upon any part of the body, but are common upon the face, hands, fingers, feet, toes, and lower extremities, also upon the palms and soles. Commonly there is little or no burning nor itching. The disease may last several weeks, the lesions coming out rapidly one after another at first, lasting a day or two in a typical condition, and then becoming darker or bloody, drying, crusting, and becoming absorbed. The fluid contents of the pustules, where these are ruptured by accident or design, are seen to be thinner than would appear from the firm aspect of the unruptured pustule. The crusts may be abundant, and of a yellowish or brownish color, or they may be insignificant, the pustule being absorbed. In no case does a permanent scar remain. The disease tends to a speedy recovery. Relapses are not common.

Impetigo occurs usually in healthy, well-nourished people. Its exact etiology has not been ascertained, but it is not connected with debility, want of proper nourishment, or derangement of the digestive system. It is rather a rare disease. In adults it generally occurs about the fingers and hands, but it is not so common among grown-up people as among children. It is not contagious.

Impetigo is to be distinguished from eczema, impetigo contagiosa, and ecthyma. From eczema it is distinguished by the superior size and development of the pustules, their small number, and separate arrangement. In addition, the pustules of impetigo do not incline to rupture, and there is rarely a crusted discharge. The opposite in all these respects is found to occur in eczema. In addition eczema is invariably accompanied by infiltration and by itching, neither of which are present in impetigo. In impetigo contagiosa, which, by the way, must not be looked upon as a variety of impetigo, but as a distinct disease, the affection begins by a vesicle, or vesico-pustule like that of vaccinia, the crust is flat, sometimes umbilicated, without any infiltration about its base; and above all there is a history of contagion. None of these characters are found in impetigo. Impetigo is often confounded with ecthyma, but in the latter affection the pustules are flat, and are surrounded by an extensive inflammatory hard base; in impetigo they are elevated and rounded, and have generally but a slight areola. In ecthyma the crusts are blackish or brownish in color, are large and flat, and are seated on a deep excoriation. Impetigo usually occurs in the strong and healthy; ecthyma in the weakly and cachectic.

The treatment of impetigo is simple. The pustules may be opened as they mature, and the contents allowed to escape. The part should be protected from rubbing and violence. The lesions may be dressed with oxide of zinc ointment, or some other mildly stimulating ointment.

Impetigo Herpetiformis.

Under this name Hebra has described a rare and grave form of disease characterized by the formation of yellowish pustules, arranged in groups or in annular form, occurring in successive outbreaks upon the periphery; each outbreak is preceded by chills, fever, and general systemic disturbance. The pustules dry into brownish crusts, which, when removed, leave a red, moist, excoriated surface. The anterior surface of the trunk and the flexor surfaces of the thighs were the chief seats of the lesions, but other regions were invaded. In the cases described by Hebra the disease occurred in pregnant women, and in one vesicles and blebs occurred as well as pustules.[1]

Dr. Duhring has called attention, in the second edition of his treatise, to a somewhat similar affection, but much milder in character, of which a number of cases have come under his notice. Having seen some of these cases with Dr. Duhring, I afterwards recognized the affection in several instances coming under my observation, and am inclined to think it occurs less rarely in this country than might be supposed. The eruption shows itself in the form of pustules and vesicles, or small bullæ, occurring in various parts of the body, very prone to recurrence, and sometimes seeming to show a sort of alternative character, with now pustules prevailing, and again vesicles and blebs. A variable amount of constitutional disturbance, with violent itching, is always present. The etiology and pathology of the disease are both obscure. It must not be confounded with eczema, ecthyma, or pemphigus, which it sometimes closely resembles.

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[1] Care must be taken by no possibility to confound this affection with impetiginous eczema, q. v.

[1] A similar case was reported by Heitzmann at the first meeting of the American Dermatological Association, at Niagara Falls, in 1877; see Archives of Dermatology, Jan., 1878.

Impetigo Contagiosa.

Impetigo contagiosa is an acute, inflammatory contagious disease, characterized by the formation of one or more superficial, discrete, roundish, or ovalish vesicopustules or blebs, the size of a split pea or finger-nail, which pass into crusts. The eruption is commoner among infants and young children. Small, isolated, flat, or slightly-raised vesicles are first seen, small in size at first, but rapidly spreading in the periphery until they become like little blebs with a thin withered-looking collapsed wall. The lesions are few in number. Usually they are discrete, but sometimes two or more coalesce. They are most commonly found about the mouth, on the chin and nose, and on the hands.[1] Crusts form in a few days, usually yellowish or straw-colored, and, as they dry, loosening at the edges, so as often to look as if they had been stuck on the skin. The surface beneath is moist and excoriated. The mucous membranes of the mouth and conjunctiva are occasionally invaded. The disease may extend from place to place by auto-inoculation. It runs its course in about ten days, tending to a spontaneous recovery. Sometimes, however, it runs an anomalous course.[2]

Impetigo contagiosa is ordinarily a disease of the lower classes, and its spread is favored by want of cleanliness. It is almost exclusively confined to children. The disease is contagious, and auto-inoculable. It sometimes follows vaccination, a fact that should be kept in mind, in consideration of the possible danger of confounding the disease with syphilis under these circumstances. It appears sometimes to occur in the form of an epidemic, and is commoner in summer. The affection is supposed to be due to a vegetable fungus, but thus far the evidence of observers has been uncertain and conflicting. It is to be distinguished from eczema pustulosum and impetigo; the history, character, and course of the lesions will settle the question. From varicella, pemphigus, and herpes iris the appearance and distribution of the lesions will distinguish the affection.

The treatment of impetigo contagiosa is of the simplest. An ointment of ten grains of ammoniated mercury to the ounce is as good a dressing for the lesions as is necessary, and this, with cleanliness, will suffice for a rapid cure.

Ecthyma.

Ecthyma is characterized by the formation of one or more discrete, flat pustules, the size of a finger-nail, situated upon a firm inflammatory base, followed by an excoriated and a brownish crust. The pustules, generally well developed, may be single or numerous. They are notably flat, broad, and seldom fully distended. At first yellowish, they are later of a reddish color; in size they vary from a small to a large finger-nail. There is usually a hard, red, tender areola. The lesions dry into flat crusts of a dark-brownish color, which, when raised, show an excoriation covered with a sanious excretion. The legs, shoulders, and back are the seat of the lesions, which come out successively day after day, while the attack lasts, each one lasting five to ten days. Sometimes there is a little feverishness before the outbreak of the eruption, which, itself, is accompanied by heat, itching, and a certain amount of pain.

Ecthyma is the outcome of want and misery; it occurs in persons who live in the slums, in prisons, and in almshouses, and who have been subjected to privation. Improper and insufficient diet, want of ventilation, excessive work, and uncleanliness are among the causes of the disease.

Ecthyma may be confounded with eczema pustulosum, impetigo, impetigo contagiosa, impetigo herpetiformis, and the large flat papular syphiloderm. From eczema it is distinguished by the size, form, and discrete arrangement of its pustules, by the indurated base, and the areola, the large flat pustule, the excoriation, and the brownish or blackish crust. The character of the pustule and crust distinguishes it from impetigo or impetigo contagiosa. From the latter its non-contagiousness and different distribution also distinguish it. The history will distinguish it from impetigo herpetiformis. From the large, flat, pustular syphiloderm, which ecthyma resembles closely in some respects, it is chiefly distinguished by its base, which is merely excoriated, whereas the removal of the crust in the syphilitic lesion shows an ulcer beneath with pus.

The internal treatment of ecthyma should be tonic and supporting. Good hygiene and diet are requisite. Rest, fresh air, bathing, cleanliness, with such nourishing food as milk, eggs, strong soups, etc., and the moderate use of stimulants or malt liquors, are all of the first importance. Iron, quinine, strychnia, and the mineral acids are of especial value. Warm alkaline baths, to soften the crusts when numerous, or cooling lotions when inflammation is present, may be employed. The lesions should be dressed with some simple, slightly stimulating ointment, as recommended in impetigo. The prognosis is favorable; a few weeks are generally enough to effect a cure, if the patient can be properly treated.

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[1] Dr. Duhring, however, reports a case where it occurred on the buttocks alone, without a history of contagion.

[2] For a fuller description, see the monograph of R. W. Taylor, of New York; Am. Jour. Syph. and Derm., Oct. 1871. p. 368; and a paper by the author, in the Phila. Medical and Surgical Reporter, Sept. 8, 1877.

PSORIASIS.

Psoriasis is a chronic disease of the skin, characterized by reddish, slightly elevated, dry, inflammatory patches, variable as to size, shape, and number, covered with abundant whitish or grayish, mother-of-pearl colored, imbricated scales. The disease varies greatly in its extent and intensity, in different cases sometimes showing a typical development, in other cases represented by one or two obscure lesions. It possesses almost invariably, however, certain characters which serve to identify it. The lesions begin as small reddish spots, scarcely raised above the level of the skin, which almost immediately become covered with whitish imbricated scales. They often develop rapidly, reaching the size of coins in a few weeks. At other times the course of the disease is more sluggish. The extent of the eruption varies greatly. A few patches may be all that are present, or the entire surface from head to foot may be involved, with scarcely a clear spot to be found. Commonly the disease shows itself in the form of variously sized scaly patches scattered over different parts of the body. The patches are characteristic. They are usually rounded, sharply defined from the surrounding skin, and consist of a mass of imbricated yellowish-white scales on a red base. When the scales are picked off, a smooth, shiny, reddish surface is shown underneath, on which can be perceived a few pin-point sized drops of blood. The abundance of the scales is a marked feature in some cases when they are formed rapidly; that is, in well-developed cases the patient's bed may be filled in the morning with a handful of scales which have accumulated during the night. When the disease exists about the joints, fissures may show themselves. There is no watery discharge at any period of the disease. Sometimes the eruption takes on a highly inflammatory character, with redness, swelling, and severe burning and itching, while at other times all these symptoms are much less marked. The affection is essentially chronic. Various names have been given to the affection, chiefly designating the size and shape of the lesions. Thus we have *P. punctata* when the eruption is of pin-head sized lesions; *P. guttata*, when they are the size of split-peas or mint-drops, and often look like splashes of mortar upon the skin; *P. nummularis*, when the lesions are the size of various coins; *P. circinata*, occurring in rings; *P. gyrata*, when gyrate forms are formed from the coalescence of partial rings; finally, *P. diffusa*, when large irregular patches occur on different parts of the body. Though the individual patches of psoriasis may be and are generally small, yet they sometimes coalesce into hand-sized patches or larger, or may even cover the greater part of a limb.

Psoriasis may occur on any part of the body, but is most apt to be seen on the extensor surfaces of the limbs. It will often be found on the elbows and knees when it shows itself nowhere else. The back is more commonly attacked than the chest, and the scalp is a frequent seat of the disease. In the latter locality it sometimes occurs in patches, but more frequently as a diffuse and abundant scaliness. It is apt to extend a little beyond the border of the scalp, especially behind the ears and on the forehead, and this is quite characteristic. Psoriasis does not occur upon the mucous membranes. The so-called psoriasis of the tongue is probably some different condition. It is not contagious.[1]

The causes which give rise to psoriasis are not known. It is commonly found in persons who enjoy blooming health, with light hair, soft skin, and ruddy complexions. On the other hand, however, it occurs now and then in persons who are in poor health, thin, meagre, and often debilitated. Psoriasis rarely occurs in children or before puberty;[2] it is apt to show itself first about the twentieth year. The disease occasionally appears to be hereditary, but rarely so. I have been able to trace a hereditary tendency in only a half dozen or so of the two to three hundred cases which have come under my notice. The seasons do not usually exercise much influence on the course of psoriasis, although in a certain number of cases it is found to be worse in winter.

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[1] Two very good illustrations of the typical forms of psoriasis will be found in Duhring's Atlas, Plates B and FF.

[2] A case has recently been reported by Dr. H. W. Stellwagon, occurring in a child between three and four years of age. Philada. Medical Times, April 23, 1881.

Diet, although exercising no influence in causing the disease, may aggravate it occasionally. Psoriasis is never produced by syphilis, nor is it connected with this disease in the remotest degree. There is a syphilitic eruption which resembles psoriasis, to which, by an unhappy fatality, was formerly given the name of "syphilitic psoriasis," a name only serving to confuse and perplex the student.[1] I had recently the opportunity of seeing a case which demonstrated beautifully the entire independence of the two affections. A man presented himself at the clinic with the eruption of psoriasis intermingled with that of the papulo-squamous syphiloderm. At a short distance the lesions of the two diseases looked precisely alike, but on close inspection they could be differentiated with certainty, and one could lay the finger on one lesion and say, "this is syphilis," and on another, half an inch distant, and say, "this is psoriasis." On questioning the patient, he admitted having suffered from a chronic skin disease of some years' standing, in the midst of which his syphilitic eruption had shown itself. Placed upon mercury, a few weeks' treatment brought the character of the different lesions into bold contrast. The syphilitic lesions had sunk to a level with the skin and were pigmentary, while those which had been pointed out as psoriasis remained unaltered.

The diagnosis of psoriasis is easy when the affection is well developed and presents its typical appearance. The form and aspect of the lesions and the history of the case will usually serve to determine its nature. Scanty and ill-developed eruptions of psoriasis are, however, at times, distinguished only with difficulty. Nevertheless, it is an important matter to accurately determine the nature of the disease, for its treatment is widely different from that of the affections with which it is liable to be confounded, its prognosis is also different, and in addition two of the other affections are contagious.

Two or three small patches of psoriasis occurring alone upon the arms or legs may be mistaken for eczema. Itching, however, is always present in eczema, and therefore itching is one sign that an eruption in question is of this nature, though not a sure one, since psoriasis also sometimes itches. In the majority of cases of eczema, there will be a history of moisture at some time. Psoriasis is always dry and scaly; never moist. The scales of psoriasis are more abundant, larger, and whiter than those of eczema. The patches of psoriasis are usually well defined in outline, while those of eczema fade into the surrounding skin.[1]

Syphilis in the form of the papulo-squamous syphiloderm is very apt to be mistaken for psoriasis, and vice versa. Psoriasis, however, is apt to be more symmetrical in its distribution. It inclines to involve a large portion of the surface at once, or to be found in regions remotely separated, which the squamous syphilitic eruption rarely does. In psoriasis, the lesions seem to be on the surface, so to speak. They are very scaly, but without much infiltration. The syphiloderm, on the other hand, is deeply indurated, and is only scantily covered with scales. In psoriasis, the knees and elbows are apt to be involved. In syphilis, these are not often attacked. Occurring on the palms or soles, the disease is apt not to be psoriasis, which is very rare in this locality. The color, though often deceptive, sometimes aids in diagnosis. It is much lighter in psoriasis, while in syphilis it is apt to be a dusky ham color. The age of the patient and the duration of the disease may give a clue to the diagnosis. Psoriasis generally first shows itself before the age of twenty; this form of syphilis later. The history of psoriasis is that of a chronic disease, lasting for years continuously or in an intermittent manner. Syphilis rarely retains one form for any length of time. Other points in the history, infection, the occurrence of other lesions, etc., may come into use. Itching is rare in syphilis, common in psoriasis. Finally, the touchstone of treatment may be resorted to in very obscure cases.

Tinea circinata and psoriasis are sometimes mistaken for one another, but the patches of tinea are less inflammatory, red and infiltrated, and are much more superficial. The scales in tinea are larger, lighter, more bulky, and the patches show no attempt at symmetry. The microscope shows evidence of fungus in tinea circinata which is absent in psoriasis, and a history of contagion may often be obtained in the former disease which is absent in the latter.

Seborrhœa, as it occurs on the scalp and also on the chest and back, sometimes resembles psoriasis. The scales in seborrhœa, however, are smaller, thinner, more bluish, or pearly in color and more disseminated. They are commonly more or less greasy and sebaceous. In the scalp seborrhœa is diffused and does not go beyond the border. Psoriasis occurs in patches and runs beyond the hairy scalp; the skin in psoriasis is more or less red and infiltrated; in seborrhœa the scalp under the scales is pale and lead-colored. Psoriasis is rarely found on the scalp without being met with elsewhere also. Seborrhœa often occurs on the scalp alone.

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[1] The confusion existing on this point was first cleared up by two papers by Dr. Duhring, published some eight years since. 1. Differential Diagnosis between Psoriasis and Syphiloderma Squamosum, Philada. Med. Times, vol. iv., 1873–4. 2. So-called Psoriasis Syphilitica. Ib.

[1] The diagnosis in some cases is almost impossible; the more so since now and then the two affections appear to run into one another. See a paper by Dr. Robert Campbell, read before the Am. Dermatol Assoc.; Archives of Dermatology, July, 1877.

The earlier and peculiarly erythematous stage of lupus erythematosus can alone be confounded with psoriasis, but the diagnosis does occasionally offer difficulties. The involvement of the sebaceous glands with their enlarged and plugged ducts will often serve to distinguish between the diseases. Lupus almost always attacks the face alone, whereas psoriasis is rarely found there without occurring also in characteristic form in other localities. The scales of lupus are yellow, and often greasy and tenacious; those of psoriasis are more whitish, and dry and imbricated. Lupus is chronic and stationary; psoriasis is apt to change its seat from time to time. There is very often a peculiar violaceous tint about lupus which is different from the frank if sometimes slightly dusky red of psoriasis.

The constitutional treatment of psoriasis, like that of eczema, should be based upon a careful study of the history and habits of the patient. Attention should be given to the patient's general health and his condition, whether stout and well nourished or thin and delicate. Regard must also be had to any functional derangement. The history of the eruption itself must also be inquired into, as to its acuteness or chronicity, as to local and constitutional treatment which may have been previously employed, together with the effects of the same. In addition inquiry should be made regarding the influence of the seasons, and whether the eruption is apt to disappear for a time and to break out again.

Fortified with this knowledge the medical treatment can be entered into intelligently. In a large majority of cases arsenic is pre-eminently the remedy. But while arsenic is as nearly a specific as in the nature of things it is possible for any medicine to be, yet it must be employed judiciously if its good effects are to be obtained, or even if we do not wish to do harm. Arsenic should not as a rule be given where there is much gastric irritation, and it is hardly necessary to say that it should not be continued should it disagree even slightly. The patient should be warned of its possible effects, and should be under the constant watch of the physician; on the first symptom of indigestion, pain in the stomach or bowels, or diarrhœa, the dose should be lessened or the use of the medicine suspended. Large toxic or almost toxic doses of arsenic do not hasten the cure of psoriasis, in fact they sometimes indirectly retard it though upsetting the stomach. Sometimes only a very minute dose is borne at first, but tolerance is afterwards established. I remember a patient in whom a single minim of Fowler's solution produced gastric symptoms, and who for a long time took only half a minim. But after a time, tolerance being established, the dose was very gradually increased until fifteen minims were taken at each dose without any unpleasant effects whatever. As a general thing arsenic should not be given in the acute stage of the disease, nor when the eruption bears an inflammatory aspect. The less heat, irritability, itching, and infiltration there is about the patches, the more benefit are we likely to get from the employment of arsenic.

Arsenic acts slowly. Where in a case of psoriasis it is going to work well, some improvement generally begins to be manifest by the end of two or three weeks; but to obtain the entire remedial effect of the drug it must be continued for months, and should generally be kept up for a considerable period after the eruption has disappeared. The most convenient form for the administration of arsenic is the liquor potassii arsenitis (Fowler's solution). *It should on no account be given to the patient unmixed, with the direction to drop out the dose.* There is no necessity of giving it thus, and it is an almost reckless exposure of the patient to the danger of mistake. I think that the physician who prescribes Fowler's solution alone, in drop doses, should be held to a strict responsibility in case of any accident occurring from overdosing. Fowler's solution may be given with wine of iron, or with a bitter infusion, as gentian, columba, or quassia, or with syrup of orange-peel or ginger and water. I often give it in water alone. It should be well diluted, and is best taken immediately after meals. A formula in common use is the following:—

℞. Liquor potassi arsenitis, fʒij.
Vini ferri, ad f℥iv. M.

Sig. A teaspoonful in a wineglass of water after meals.

The dose here is four minims, a fair average dose for an adult. The amount may be gradually increased, say every week, until an effect upon the eruption becomes perceptible, or until the limit of tolerance is reached.

Sometimes it is desirable to give arsenic in pill form. In this case the following formula, known as the Asiatic pill, may be employed.

℞. Acidi arseniosi, gr. ij.
Piperis nigræ, ℈ij.
Pulv. glycyrrhizæ rad., ℈ij. M.
Fiant pil. No. xl.
Sig. One after meals.

This form of administration is not so satisfactory as the former; the action of the arsenic is uncertain, and gastric disturbance is more apt to be caused. Arsenious acid may also be given in powders.

℞. Acidi arseniosi, gr. ij.
Sacch. lactis, gr. c. M.
Fiant chart. No. xx.
Sig. One after meals.

Fractional trituration must be employed with great care to have the arsenic evenly distributed through the powders.

There are some cases of psoriasis where tonics are called for. In pale, thin, anæmic persons, iron is often the best remedy. In other cases cod-liver oil is of service, and I have seen one or the other of these remedies cure when arsenic has failed. Phosphorus is recommended by some writers, and may be tried in obstinate cases, as also may tar, which McCall Anderson says sometimes cures when arsenic fails. Alkalies are found beneficial when there is a gouty or rheumatic tendency. Liquor potassæ, in ten- or twenty-drop doses, well diluted, may be used in these cases, as also may the carbonate of ammonium, in ten- to thirty-grain doses. Where the inflammatory element is strongly marked, acetate of potassium, in half-drachm doses, may be given three or four times daily, in a wineglass or more of water. Alkaline mineral waters are also of value. Diet, with a direct view to influence the disease, is of no avail; of course the digestive organs must be looked after, and, if dyspepsia is present, then diet may be of indirect use.

The local treatment of psoriasis is of more or less importance, according to the nature of the case. When the lesions are small and widely distributed, and there are no disagreeable subjective symptoms, it is generally more convenient to depend upon constitutional remedies so long as these act satisfactorily. There are many cases, however, when either the disease exists in a few large patches which are easy to handle locally, or the eruption is situated in some conspicuous locality, or the subjective symptoms of burning and itching demand relief; in these cases local treatment is required. The local treatment of psoriasis must be carefully regulated with reference to the case. In young persons, or females with tender skins, the same amount of stimulation will not be borne as may be used with impunity in a thick-skinned "Seifenscheu" (soap-shy) German. I remember that when sapo viridis was first introduced into this country, some dozen years since, psoriasis patients were sometimes rubbed all over with it, after the fashion of the Viennese clinics. Unfortunately the exact directions of the German physicians were not followed, and water being applied shortly afterwards, the skin of the unhappy patients became spanned and cracked in every direction from head to foot, causing agony for days. The effect, in fact, was very much as if they had been painted with dilute solution of caustic potassa. I may say here that sapo viridis can scarcely ever be used over extensive surfaces, and that it should always be followed by some unctuous material to prevent its after-effect. Sapo viridis, or its solution in one-half its weight of alcohol, the spiritus saponis kalinus, described above under the treatment of eczema, form excellent applications for the purpose of cleansing the scaly patches of psoriasis before applying other remedies. In connection with the simple or alkaline warm bath they form the best preparation for distinctly curative applications.

If the case is an acute one soothing applications must be used. Inunctions with olive oil several times in the course of the twenty-four hours are of great benefit and comfort, especially when the eruption is extensive or universal. Other soothing applications, as the unguentum diachyli or McCall Anderson's ointment (p. 730) may be used. Commonly, however, the eruption is chronic, and stimulating remedies are to be employed. The patches having been deprived of their scales, tar in some form may be applied, at first over a small area to ascertain if it agrees with the skin, which it sometimes does not, and later over the whole eruption. When tar does not agree the eruption becomes red and swollen, hot, itchy, or painful. Usually tar is well borne. The following is a good formula for general use :—

℞. Picis liquidæ, ʒj.
Ung. aquæ rosæ, ℥j. M.
Oil of cade may be substituted for the tar.

Another good preparation for general use is this :—

℞. Ol. cadini, ʒj.
Alcoholis, f℥j. M.
To be applied with a stiff brush, or a bit of flannel.

This is particularly useful in psoriasis of the scalp. The scales are first to be thoroughly removed by shampooing the scalp with one part of the spiritus saponis kalinus to four parts of water. These removed, the tarry preparation must be vigorously applied to the scalp itself along a series of "parts" made in the hair. This, as all similar applications, should be rubbed firmly into the skin, not smeared on the surface. Patients require to have this explained and insisted upon, and must be reminded of it from time to time. So much depends upon the patient in making local applications in skin-diseases that the physician is, to some extent, at the patient's mercy, and must guard his responsibility by explicit directions. A liquid preparation of tar with an alkali, known as tinctura saponis cum pice, is often very useful rubbed into localized patches. This is its composition:—

℞. Saponis viridis,
Picis liquidæ,
Alcoholis, āā ℥j. M.

Creasote in ointment, of the strength of one to four drachms to the ounce, is well spoken of. Crocker[1] proposes thymol as a substitute for the tarry preparations. It is colorless and without disagreeable odor,—two decided advantages. It may be used as an ointment, in the strength of five to thirty grains to the ounce. In small patches, limited in number, ointment of nitrate of mercury, either in full strength or of one to four drachms of the officinal to the ounce of cold cream, may be employed. Biniodide of mercury, from five to fifteen grains to the ounce, is also useful. Small and obstinate patches may occasionally be blistered to advantage.

In the last few years, however, two local remedies for psoriasis have been introduced, which are, I think, likely to prove more useful than any others in the majority of cases of psoriasis. These are chrysarobin, wrongly called chrysophanic acid, and pyrogallic acid. The first is a yellow powder, derived from Goa powder, and introduced to the profession by Mr. Balmanno Squire, of London. It is soluble in alcohol, benzol, and hot fat, and is best used in the form of an ointment, varying in strength from ten grains to one drachm to the ounce of ointment. After a few applications of this ointment the scales disappear, and the patches assume a dead whitish color, with a purplish brownish discoloration about their edges and over the skin with which the ointment has come into contact. This remedy must be used with circumspection, particularly about the face, where it is apt to give rise to œdema and dermatitis. This tendency to inflame the skin is one of the drawbacks to the use of the remedy, and the patient who is under treatment by chrysarobin must be watched to prevent the development of irritation. Another objection to the use of the remedy is its dyeing properties. It not only discolors the skin but the hair as well, and ruins in the same way all clothing with which it may come in contact, since it contains a vivid purple dye. Nevertheless, chrysarobin, properly handled, is the most valuable local remedy we possess in psoriasis.

Next to chrysarobin comes pyrogallic acid, which acts in the same manner but somewhat more feebly. It does not, however, materially discolor the skin or clothing, and does not arouse dermatitis. Used over large areas, however, it has developed symptoms of poisoning from absorption, and it must be used over only a small portion of the body at one time. It is used in the form of an ointment, in the strength of one-half to two drachms to the ounce of ointment.

Psoriasis tends to relapse, and is often very rebellious to treatment. The prognosis as to the individual attack, in medium and mild cases, is usually favorable, but the physician should warn the patient that the affection is liable to return.

FURUNCULUS.

Furunculus, commonly known as boil, is a deep-seated inflammatory disease, characterized by one or more variously-sized, circumscribed, rounded, more or less acuminated, firm, painful formations, usually terminating in central suppuration. Boils may occur singly, or oftener in numbers. When they occur in successive crops, the condition is known as furunculosis. The lesion, at first a small, ill-defined reddish spot, situated in the true skin, and tender and painful from the first, soon becomes larger, slightly elevated, and shows a tendency to suppurate about its centre. It arrives at maturity in a week or ten days, and is then a slightly-raised rounded or pointed formation, with a suppurating centre called the *core*. At times no centre of suppuration forms: it is then called a "blind boil." The size of the boil may vary from that of a split pea to a large coin. Its color is dusky red; it usually gives rise to a dull throbbing pain, increasing in intensity until suppuration takes place, and then subsiding. Boils are exquisitely tender; the least touch causes pain.

Though the boil may attack any part of the body, its favorite seats are the face, ears, neck, back, axillæ, buttocks, perineum, scrotum, labia, and legs. Sometimes it is accompanied by some general constitutional disturbance. Neighboring glands may be sympathetically enlarged.

Boils sometimes occur as complications or sequelæ of other diseases, *e. g.*, eczema. I often have occasion to observe an acute attack of eczema wind up with crops ot boils. Sometimes the boil tends to return indefinitely at or about the same point. Some years ago I had two young men under observation, in whom successive boils occurred in the lobe of one ear, occurring with intervals of one or two months for several years in succession.

The causes giving rise to boils are various and sometimes obscure. Often they are the result of a low and depraved condition of the system. General debility, overwork of a mental sort, excessive bodily fatigue, nervous depression, improper food, and irregularity of the functions of the body, are among the commoner causes of boils. I have sometimes encountered them, however, in persons apparently enjoying perfect health, and given over to active and varied outdoor exercise and amusement. The boils to which the hydropathist points with pride, as evidence that peccant humors are being "driven out," are in reality the evil result of erroneous hygiene and regimen. Boils not infrequently occur in the course of other diseases, as diabetes, chlorosis, fevers, uræmia, and septic pyæmia. Occasionally certain atmospheric conditions, prevailing chiefly in the spring and autumn, seem influential in determining the occurrence of boils, which at times appear to prevail as an epidemic.

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[1] British Medical Journal, Feb. 16, 1878.

The diagnosis of furuncle is generally easy, the affection being familiar to every one. From anthrax or carbuncle it differs in having only one point of suppuration, the core, while the former has several or many such centres. The furuncle, also, is inclined to be rounded or acuminate; the carbuncle is flat. Furuncle is small; carbuncle varies in size from one to ten or more centimetres in diameter. Furuncle is tender to the touch; carbuncle, though spontaneously painful, is not tender. Boils generally occur in numbers; carbuncle is commonly single.

The treatment of furunculosis is at times by no means easy. Each case requires careful study, with the view, if possible, of ascertaining the cause at work, and obviating this when possible. The various functions of the body are to be carefully regulated. The diet should be of good quality and varied; wine and malt liquors may be prescribed; the regimen moderate and conducive to the general improvement of the system. Fresh air and outdoor exercise are to be urged in most cases. Tonics are very often called for. Quinine in considerable doses, as much as sixteen grains per diem, and iron alone or with strychnia may be given. The "mistura ferri acida," mentioned above under eczema, as well as arsenic alone or in connection with iron, will be found serviceable at one time or another. Other remedies are: the sulphite or hyposulphite of sodium in fifteen- or thirty-grain doses every two or three hours; sulphide of calcium in doses of an eighth to one-quarter of a grain every two hours; liquor potassæ in ten- to twenty-minim doses, with a bitter infusion, as calumba or quassia; fresh yeast in tablespoonful doses three times daily; syrup of the hypophosphites of lime, iron, soda, and potassa, as recommended by Piffard; tar-water up to a quart daily; phosphorus. Such are the remedies most usually to be relied upon in the treatment of furunculosis. No one can be recommended above the rest; what will suit one case will not suit another.

The prognosis of furunculosis is a little uncertain as regards time; relapses are apt to occur. Sometimes change of climate and travel are required to break up its recurrences.[1]

ANTHRAX.

Anthrax is a hard, more or less circumscribed, dark red, painful, deep-seated inflammation of the skin and subcutaneous connective-tissue, variable as to size, terminating in a slough. Carbuncle is usually accompanied by a good deal of constitutional disturbance. It is ushered in by a chill followed by fever. The skin over the affected part becomes hot and painful, and a firm, flat, more or less sharply circumscribed inflammation of a somewhat dusky red hue forms, which is deeply seated in the tissues. It is painful, with commonly more or less of a burning sensation. The symptoms become gradually more marked during ten days to two weeks, when the tissues begin to break down and soften, and the skin becomes gangrenous. Perforations appear at various points, either filled with tough fibrous yellow *cores*, or hollow; and from these issues a yellow sanious fluid. The surface soon assumes a cribriform or sieve-like appearance, which is very characteristic. Unless the carbuncle is small, the whole skin covering it usually sloughs sooner or later, leaving a large open ulcer healing slowly.

The duration of carbuncle is usually from four to six weeks, though its course depends somewhat on the age and strength of the patient. It is usually single, and its favorite seats are on the back of the neck, shoulders, back, and buttocks. It is a serious disease in elderly persons, and when extensive is liable to terminate fatally. Boils are apt to appear about the borders of carbuncle. The affection sometimes occurs in connection with diabetes.

The causes are, so far as can be conjectured, similar to those which give rise to furuncles. The disease is not a group of boils, but a much more deeply seated and serious affection.

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[1] For an account of the affections known as *Aleppo Bouton, boil or evil*, *Delhi boil*, and *Biskra Bouton*, see "On certain Endemic Skin- and other Diseases of India and Hot Climates generally," by Tilbury Fox, M.D., and T. Farquhar, M.D., London, 1876; also, Geber, Vierteljahressch. f. Derm. u. Syph., 4tes Hft., 1874, p. 445.

Carbuncle is distinguished from furuncle by its size, flatness, course, multiple points of suppuration, and extensive slough. From erysipelas, which it sometimes resembles in its early stages, its circumscribed outline will soon distinguish it.

The general treatment of carbuncle should be strongly supporting. The most nourishing foods, and stimulants, must be freely given. Tincture of iron and quinine are the best medicines. The latter should be given in sixteen to twenty-five grain doses once daily. Anodynes should be given freely when required to procure rest at night. Fresh air and exercise, when these can be taken, are important factors. When the carbuncle is tense and hard, deep cruciform incisions for relief have the sanction of old usage to recommend them. The majority of cases, however, according to Sir James Paget,[1] do equally well without cutting. Dr. D. H. Agnew[2] suggests painting cantharidal collodion around the carbuncle in a broad band, the effect of the blister being to remove the tension. Among dressings, Hebra recommends cloths wrung out of cold water or ice bags in the early stage. So soon as suppuration begins, warm fomentations, poultices, etc., are to be used. These tend to relieve the tension of the tissues and hasten the discharge of the slough. The poultices are best made with flaxseed-meal or corn-meal; they should be put on hot and changed frequently. The parts should be kept clean, washed frequently with a weak carbolic acid solution, and the slough removed as rapidly as possible, so as to leave as little as possible of the diseased tissue in contact with the springing granulations. When the ulcer begins to granulate it must be encouraged to heal. The prognosis should be extremely guarded.

POISONED WOUNDS.[3]—A number of small insects, as certain kinds of midges and flies, the mosquito,[4] flea, bed-bug, bee, wasp, spider, scorpion, etc., chiefly those met with in hot climates, produce poisoned wounds, differing in character and severity. The lesions produced often resemble urticaria and purpura, and the effect may not be limited to the inoculated point only.[1] The treatment is usually purely local and sedative.

DISSECTION-WOUNDS.—These may give rise to merely local appearances, or to general symptoms with severe constitutional disturbance. The first lesion, which generally occurs on the hand at the seat of some former abrasion, is a small vesicle or pustule situated on a hard inflammatory base, or at times a patch of dusky red infiltration. There is at first more or less burning and itching, which may be followed by pain, usually extending up the arm to the axilla, lymphangitis, and constitutional symptoms. When the affection is local, the epidermis may become thick and fissured, the sore secreting a thick or thin fluid resulting in a crust. Sometimes the lesion assumes an indolent tubercular or warty character, as described by Wilks, under the name of verruca necrogenica.[2] It is also known as "dissection" and "post-mortem" tubercle. Its usual seat is about the fingers and joints. It is usually rebellious to treatment. The best remedies are stimulating ointments, as the mercurials, nitrate of silver, caustic potassa, and acetic acid.

MALIGNANT PUSTULE.—This affection has given rise to a good deal of discussion in France of late, but has been very little heard of in this country. It is due to the inoculation of a virulent poison generated in cattle suffering from the disease known as murrain or charbon. After inoculation, which usually takes place about the hands of those who deal with cattle and hides, the period of incubation is very short,—only a few hours, when the part is attacked by pain, burning, and itching, followed by the formation of a vesicle or pustule, with an extensive hard areola, on which vesicles are sometimes seated. The pustule increases to the size of a coin; a slough forms which soon breaks down into an unhealthy ulcer; the patient not unfrequently succumbing. The disease may also be induced by the bite of flies, acting as carriers of the specific poison. The treatment of malignant pustule, to be successful, must be prompt and thorough. Cauterization is usually recommended, but lately good results have been obtained by injections of carbolic acid. Trélat,[1] in a typical case, made a deep incision through the slough and applied Vienna paste, after which he made four injections of twenty per cent. solution of carbolic acid in the vesicular zone. The next day there was some improvement; the number of injections was increased to ten, and the improvement continued; the injections were then reduced by two daily. Carbolic acid had been given internally. Eight days later all the alarming symptoms had disappeared and the patient was practically well.

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[1] On the treatment of carbuncle. Clinical Lectures and Essays. London, 1875.

[2] Principles and Practice of Surgery, vol. i., Phila., 1878.

[3] See, for fuller description, Agnew's Principles and Practice of Surgery, vol. i., Phila., 1878; and Gross's System of Surgery, Phila., 1872.

[4] See an interesting paper, by Dr. Jas. C. White, of Boston, giving cases where serious symptoms were produced by the bite of large numbers of mosquitoes. "On the protection acquired by the human skin, and other tissues against the action of certain animal poisons after repeated inoculations." Boston Med. and Surg. Journ., Nov. 9, 1871.

[1] See a case where a wasp-sting of the œsophagus produced generalized urticaria. De Ranse, Gaz. Méd. de Paris, p. 476, Sept., 1875.

[2] Guy's Hospital Reports, 3d ser., vol. viii.

Glanders.—Mention may be here made of the malignant contagious disease known as glanders, farcy, or equinia, derived from the horse, and manifesting itself after a period of incubation by grave constitutional symptoms, with inflammation of the nasal and respiratory passages, and a deep-seated, pustular, vegetating, tubercular ("farcy-buds"), or hemorrhagic, ulcerative form of eruption. The disease is rare and frequently fatal; no specific treatment has been recommended.

Dermatitis.

Under the head of dermatitis, signifying merely inflammation of the skin, are to be grouped a number of inflammatory affections which have not been included under other heads. These usually, though not always, result from external agencies, as heat, cold, irritating chemicals, etc. There may be erythema only, or vesicles, pustules, blebs, or gangrene may supervene. The affection may be generalized, as in dermatitis from poisonous substances ingested, or circumscribed, as in traumatic dermatitis. According to the causes producing this form of inflammatory disease of the skin we may have:—

Traumatic Dermatitis.

This is due to violence to the skin.

Under this head are included contusions, abrasions, excoriations depending upon scratching, etc.

Dermatitis Venenata.

This is produced by poison-oak and ivy, poisonous sumach, nettle, mezereon, arnica, etc. Rhus poisoning is the most important of these forms of dermatitis. It prevails chiefly in the spring and autumn, and varies much in intensity in different parts of the country, occurring in a very severe form in California, for instance. Personal idiosyncrasy likewise plays an important part. An exposure to direct contact with the poison vine or oak may be endured by one person with impunity, while another, susceptible to the influence of the rhus, will be severely attacked as a result of exposure to the smoke alone of the burning vines, or even to the wind blowing over the fresh ones.[1] The poison is readily conveyed from the hands, the usual point of contagion, to the face and genitalia, which are very apt to become the seat of the disease also. The eruption usually follows exposure within a few hours. It may be erythematous or vesicular, but is usually the latter. The vesicles may be few in number and ill developed, or they may be numerous, of various sizes crowded together, and seated on an inflamed or œdematous base. Swelling, heat, and itching are among the most marked symptoms. Sometimes the parts attacked, as the face, are much swollen and disfigured. The lesions run an acute course, usually rupturing and drying into yellowish crusts. The affection may last from one to six weeks. In persons predisposed to eczema, an attack of this affection may follow. This should be borne in mind in giving a prognosis.

Local treatment alone is usually required. Of the innumerable remedies recommended from time to time in the medical journals, the majority owe their reputation to their success in curing isolated cases. In a disease like dermatitis venenata, which is so often self-limited, a few cases successfully treated form an insufficient basis for the recommendation of a new remedy. Fortunately a few old remedies are in use which are amply sufficient. These are for the most part sedatives and astringents. Dilute lead-water is popular and useful. Black wash employed as a lotion for a quarter of an hour at a time, every three or four hours, as recommended by Dr. White, is a very serviceable application. Decoction of white oak bark is also useful. The remedy, however, which I have used almost exclusively for the past three or four years, is the fluid extract of grindelia robusta, diluted to the extent of two drachms of the extract to the pint of water. In some cases astringent powders may be used.

Akin to dermatitis venenata is that form of inflammation of the skin which is brought about by the use of poisonous clothing. Stockings or underclothing dyed with aniline red, yellow or brown morocco hat bands or shoe linings, or green tulle dresses, are among the forms of clothing most likely to give rise to dermatitis. Tincture of arnica and other medicinal agents sometimes give rise to dermatitis, and advantage is sometimes taken of the action of these remedies to produce feigned eruptions. Nitric acid and cantharides have been used for producing factitious pemphigus, and mustard plasters and turpentine have been employed to cause erythema.[1]

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[1] Comptes Rendus de l'Académie de Méd. Le Progrès Méd., 1881, p. 143.

[1] See an article by Dr. James C. White, "On the Action of Rhus Venenata and Rhus Toxicodendron on the Human Skin." New York Med. Journal, March, 1873.

DERMATITIS CALORICA includes the inflammatory symptoms produced by heat and cold in the form of burns and frost-bites. They may take the form of erythematous, vesicular, bullous, or gangrenous eruptions.

DERMATITIS GANGRÆNOSA is a rare affection which has chiefly come to notice during the past few years through a number of reports published in the medical journals. It may be idiopathic or symptomatic. The idiopathic form shows a tendency to symmetrical manifestation. It begins usually in the form of small or large, circular, erythematous, reddish, or purplish spots, which may be tender and painful, or without sensation; after undergoing a more or less variable course they become gangrenous and slough, the process terminating fatally or in recovery, the latter event taking place sometimes in the gravest cases. There is usually some constitutional disturbance, fever, malaise, debility, etc.; cases have been reported by Fagge,[2] Brodie,[3] Stockwell,[4] Rooke,[5] and Petri.[6] Gangrenous patches may follow nerve-lesions, or may occur also in connection with grave cerebral or spinal diseases, as in the form of acute bed-sore.[7] These form the symptomatic form of gangrene.

In all cases of gangrene of the skin and the like, care should be used to exclude artificial and feigned diseases.[8]

DERMATITIS MEDICAMENTOSA. — Affections of the skin due to the ingestion of medicinal agents have only lately attracted attention.[1] They are mostly of two classes, either a diffuse erythematous, papular, or petechial eruption, or an involvement of the glands with the formation of pustules, furuncular or phlegmonous lesions. The drugs thus far known to have given rise to eruptions of the skin, are as follows: ARSENIC may give rise to dermatitis of an erysipelatous type, papular, urticaria-form, vesicular, and herpetiform eruptions.[2] Pustular and furuncular eruptions are also said to have been observed. BELLADONNA gives rise at times to an erythematous or scarlatiniform eruption, and sometimes to an erythemato-papul arrash. BROMINE, or rather its salts, gives occasion to the occurrence of maculo-papular, pustular, or phlegmonous eruptions. CANNABIS INDICA has been known to cause a vesicular eruption. CHLORAL may give rise to an erythematous condition, or to papular, urticaria-form, vesicular, pustular, and now and then to more or less severe petechial eruption. COPAIBA commonly gives rise to an erythematous or roseolar eruption. Bullous eruptions have, however, been reported as resulting from its use. CUBEBS has been reported as causing a roseola-like eruption, and DIGITALIS a scarlatiniform eruption with papular erythematous lesions. IODINE alone, or in combination, often causes the appearance of eruptions of the skin, of which the form may be erythematous, papular, vesicular, bullous, pustular, or hemorrhagic. Of these, the pustular is the commonest, and in its acneiform modification is well known. Occasionally it may assume a phlegmonous form resembling some syphilitic eruptions. MERCURY commonly gives rise to erythematous and scarlatiniform eruptions, though cases have been described where vesicles, bullæ, pustules, and phlegmon have been observed. MORPHIA or OPIUM usually gives occasion to a scarlatiniform rash, which attacks the flexor surfaces by preference, and is sometimes followed by extensive desquamation. PHOSPHORIC ACID is reported in one instance to have given rise to a bullous eruption. QUININE and CIN-

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[1] See a paper by the late Mr. Startin, of London, on "Feigned Diseases of the Skin." Brit. Med. Journ., Jan. 8, 1870; also an article by Dr. Fagge on the same subject in the same journal for February 12, and March 26, 1870.

[2] Guy's Hospital Reports, vol. xiii., 3d ser., 1868.

[3] The Works of Sir Benjamin Brodie, 1865, vol. iii., p. 392.

[4] British Medical Journal, February 12, 1870.

[5] Lancet, 1864, vol. ii., p. 486.

[6] Berlin Klin. Wochens., 1879, p. 509. Abstract in Phila. Med. Times, Jan. 3, 1880.

[7] See Charcot, "Diseases of the Nervous System." New Sydenham Society's Translation, London, 1877.

Tilbury Fox, Lancet, Oct. 30, 1875.

[1] See a paper by the author, read at the Fourth Annual Meeting of the American Dermatological Association, and published in the Archives of Dermatology, October, 1880, on "Medicinal Eruptions," giving an analysis of all cases reported up to that date.

[2] Whether arsenic can give rise to an eruption resembling herpes zoster is a mooted point. Several cases have been reported where the coincidence has been striking. Dermatologists, however, differ on this question. See Transactions of the American Dermatological Association, at the Fourth Annual Meeting, held in Newport, R. I., 1880.

CHONA now and then give occasion to the appearance of very striking eruptions resembling the rash of scarlatina or measles; occasionally papular, urticariaform, hemorrhagic, or even gangrenous eruptions are found to follow the ingestion of these drugs. SALICYLIC ACID now and then produces a scarlatiniform eruption, and cases have been reported where vesicular and petechial eruptions have followed its use. SANTONINE, and STRYCHNIA, have been reported in single instances as producing eruptions, as also have TAR, CARBOLIC ACID, TURPENTINE, ROSIN, and PETROLEUM. The medicinal eruptions are sometimes difficult to make out. Their history, and their cessation after the suspension of the medicine, will usually serve in deciding the diagnosis.

CLASS III.—HEMORRHAGES.

PURPURA.

Purpura consists in the development of variously sized and shaped, non-elevated, or raised, smooth, reddish, hemorrhagic patches, characterized by not disappearing under pressure.

Purpura simplex is that variety of the disease which is characterized by the more or less sudden appearance of bright reddish, claret-colored, or purplish, sharply circumscribed, roundish, ovalish, or irregularly-shaped hemorrhagic spots.[1] These vary in size from a pin-point to a bean. They usually occur in considerable numbers, and are more apt to be found upon the lower extremities,[2] though they may occur on any part of the surface. They are apt to be scattered about over a considerable area. There are usually no subjective symptoms as itching, etc.; occasionally, the outbreak of the eruption is preceded by malaise and loss of appetite, with a sense of fatigue.

Purpura urticans is a form of purpura where wheals occur in connection with the hemorrhagic spots. Under this head may be classed the so-called neurotic purpura, when the nervous system is manifestly at fault.[3] Blebs have been noted in association with purpura in a case reported by Dr. J. C. White, of Boston.[1] Reference has been made under medicinal eruptions to the hemorrhagic effusions due to various drugs.

Purpura occurs more commonly in the old than in the young. The attack may last from two to four weeks. Relapses are apt to take place in the form of repeated crops of the spots in the course of the disease. The causes of purpura are usually obscure; it occurs in the healthy as well as in the debilitated.

Purpura can scarcely be mistaken for any other disease. Flea-bites only resemble the eruption; these always show the punctured wound of the insect in the centre of the hemorrhage, with a congested areola around it.

Purpura rheumatica is a form of purpura which is ushered in with more or less fever, lassitude, loss of appetite, and depression, with marked rheumatic pains throughout the body, more particularly about the joints of the lower extremities. The spots are pinkish or darker in color, and are sometimes raised above the skin. There are no accompanying symptoms in the lesions, but the skin generally may be sore. Fresh crops of the eruption may appear, and the disease may run on for weeks or months with lassitude, rheumatic pains, etc., as marked symptoms. Sometimes the rheumatic symptoms are prominent, and there are few lesions upon the skin, so that it seems like a simple rheumatism; at other times the eruption may be more abundant, when it may be mistaken for the macular syphiloderm.[2]

Purpura hemorrhagica is a much more serious form of the disease than those above noted. The premonitory symptoms are more marked, and the patient often feels as if threatened with the advent of some serious malady. The spots when they make their appearance are found in all parts of the body, and vary in size from a small coin to the palm of the hand. They may coalesce and form variously shaped irregular patches. Hemorrhage from the gums, mouth, nostrils, bowels, and bladder, may take place to a slight or to a severe degree. The disease may last a week or a month, relapses occurring. It is a serious disease, and may end fatally. It may occur in both children and adults, and in the strong and healthy as well as in the delicate.

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[1] The eruption sometimes assumes a curious circinate form, as in a case observed in Dr. Duhring's Clinic, at the University Hospital. See a Clinical Report, Phil. Med. and Surg. Reporter, Aug. 3, 1878.

[2] See Duhring's Atlas, Plate K.

[3] See Dr. Weir Mitchell, in the Amer. Journ. Med. Sci., July, 1869, p. 116, and Tyrrell, Pacific Med. and Surg. Journ., June, 1876. The latter believes in the close connection of malaria which coincided with the occurrence of his cases.

[1] A case of recurrent cutaneous hemorrhage with urticarial and bullous efflorescence. Boston Med. and Surg. Journ., Oct. 10, 1878.

[2] See a paper by Dr. Duhring in the Phila. Med. Times, vol. iii., p. 545, 1873.

Dr. Kinnicutt, of New York, has reported a number of cases of this form of purpura in the Archives of Dermatology, vol. i., p. 193.

Purpura hemorrhagica is apt to be mistaken for scurvy. The following table[1] will show the points of difference.

SCURVY	PURPURA HEMORRHAGICA
1. Is due to privation from vegetables and to depressing circumstances, and is cured by lime-juice and fruit.	1. Is not produced by want of vegetables, and lime-juice has no influence on its course.
2. Affects usually many persons at the same time.	2. Occurs sporadically.
3. The gums become spongy, the teeth loose, and painful subcutaneous ecchymoses, prone to suppuration, may occur.	3. No affection of gums or painful ecchymoses.
4. Is attended with great prostration and a peculiar dusky pallor of skin.	4. Prostration only proportionate to loss of blood; skin anæmic.
5. Death occurs rarely from hemorrhage, usually from serous effusions or septicæmia.	5. Death results from asthenia or syncope, the result of hemorrhage.

In addition, the premonitory symptoms in purpura may not be characteristic, or may be wanting entirely, while in scurvy they form a well-defined group, consisting of absolute weakness and general debility, impaired circulation, tumefaction of the gums with bleeding, and looseness of the teeth. Purpura is apt to come out suddenly; scurvy always makes its appearance slowly.

In the treatment of purpura, attention must first be paid to the removal of the cause if this can be ascertained. Nutritious diet, and, if the hemorrhage be extensive, above all, rest in the horizontal position are important. In purpura simplex, ergot, the preparations of iron, quinine, the mineral acids, together with frictions and cold baths, are beneficial. Purpura hemorrhagica calls for prompt and decided treatment. Perfect rest in the horizontal position, with the same medical treatment as in purpura simplex is appropriate. Hypodermic injections of ergot, as recommended by Minich,[1] are to be employed; electricity has been used by Shand[2] where other remedies have failed. In ordinary cases, tincture of the chloride of iron, in doses of twenty to thirty drops thrice daily, alone or with digitalis and ergot, may be given. Turpentine and the acetate of lead with opium may also be given. Externally, sponging with vinegar, solutions of tannin, alum, etc., are recommended by authorities. I have not had occasion to use them. Ice applied locally, and ice-water enemata, where there is hemorrhage from the bowels, may be employed with benefit.

The prognosis of all forms of purpura except purpura hemorrhagica is good. The disease in all forms is apt to be stubborn; P. rheumatica, particularly so. The prognosis of purpura hemorrhagica should be guarded, as it is a treacherous and serious disease.

Under the head of hemorrhages, some brief mention may be made of *hematidrosis*, or bloody sweat, which consists in the appearance at the outlets of the excretory ducts of the sweat-glands of a reddish fluid containing blood. It is usually in small quantity and localized, and is a cutaneous hemorrhage taking place about the sweat-glands, and emptying itself through the sweat-ducts. It is a very rare disease.[2]

Closely connected with this form of cutaneous hemorrhage is that known as *bleeding stigmata*, of which one of the earliest cases on record is that of St. Francis of Assisi, in the eleventh century. The fact of the occurrence of stigmata, in the case of St. Francis, has, I think, been proved beyond doubt. A recent case of some notoriety is that of Louise Lateau, a young Belgian girl. In this case, the hemorrhages were connected with ecstasy and other nervous phenomena.[3]

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[1] Phila. Med. Times, May 8, 1875.

[2] Lancet, July 19, 1879.

[1] Taken from Mr. Malcolm Morris's Manual of Skin-Diseases, Am. ed., p. 193.

[2] Cases have been reported by Hart (Richmond and Louisville Med. Journ., Jan., 1875, p. 98), and McCall Anderson (Journal of Cutaneous Medicine, Oct. 1867; also Lectures on Clin. Med., London, 1877).

[3] See Warlomont (Louise Lateau, Rapport Médical. Paris et Bruxelles, 1875), and Lefébre (Louise Lateau, de Bois d'Haine; sa vie, ses ecstases, ses stigmates, Louvain, 1874). A similar case has been reported from Bahia. (Le Mouvement Médical, No. 1, 1877.)

CLASS IV.—HYPERTROPHIES.

(1) OF PIGMENT.

LENTIGO—CHLOASMA—NÆVUS PIGMENTOSUS.

Lentigo or freckles, though a common affection, is so unimportant as to demand only a passing notice. Their ordinary seat is upon the face, but they may occur in any part of the body. They are rarely seen before the third year, and tend to disappear spontaneously in older persons. Freckles of an intense dark brownish or blackish color are met with as one of the symptoms in the rare disease known as "xeroderma of Hebra."[1] The remedies employed in lentigo are the same as those used in chloasma.

Chloasma, sometimes called "melanoderma,"[2] is a discoloration of the skin, occurring in variously-sized and shaped patches, of a yellowish, brownish, or blackish tint. It may occur over a part or over the entire surface, and may be idiopathic, the result of external agencies, as scratching, blistering, and heat, or symptomatic. Belonging to the latter category may be mentioned chloasma uterinum, the pigmentation of Addison's disease, and those discolorations which occur in connection with certain general diseases, as tuberculosis, cancer, malaria, etc.

The most important variety of chloasma is chloasma uterinum, which consists in the presence of one or several patches of pigment-deposit, appearing usually about the forehead, extending across from side to side, from below the base of the scalp to just above the eyebrows, in a broken or continuous band. Occasionally the whole face may be covered as with a mask. The discoloration may also occur elsewhere on the body. The affection occurs between puberty and middle age, is more frequent in married women, and is caused by pregnancy or by uterine derangements. In single women it generally occurs between the ages of thirty and forty, and does not show itself after the climacteric period in either the single or the married.

Chloasma is apt to be mistaken for tinea versicolor, on account of the similarity in color. The distribution of the disease is quite different, however (see tinea versicolor), and the presence or absence of fungus will settle the question.

The treatment of chloasma should first be directed to the removal of the cause when this is possible. Without this all external treatment is apt to be disappointing. The discoloration may be removed from the skin temporarily by means of certain washes which cause desquamation of the superficial layers of the epidermis. These must be used at first with some caution, to prevent a too severe action upon the skin. The following formula is well spoken of by Hardy:—

℞. Hydrarg. chlorid. corros., gr. viiss.
Zinci sulphatis, ʒss.
Plumbi subacetatis, ʒss.
Aquæ, ℥iv. M.
Sig. Lotion. Apply morning and evening.

Bulkley suggests the following combination:—

℞. Hydrarg. chlorid. corros., gr. vj.
Acidi acetici diluti, fʒij.
Boracis, ℈ij.
Aquæ rosæ, fʒiv. M.
Sig. Lotion. Apply twice daily.

Argyria is a form of discoloration of the skin occurring after the prolonged use of nitrate of silver. Iodide of potassium has been employed internally with success in two cases of this condition.[1]

Nævus pigmentosus, or pigmentary mole, may be of various size and shape, with a soft and smooth surface, constituting *nævus spilus;* or uneven, rough, and warty, forming *nævus verrucosus;* or it may occur in the form of thick, soft, fatty connective-tissue growths, when it comes under the head of *nævus lipomatodes.* When the growth is covered with hair, it is called *nævus pilosus.*

Pigmentary nævi may be single or multiple.[2] They may occur in the course of nerve-tracts, or, more frequently, irregularly scattered over the surface. They may be removed by means of the knife or with caustics; when they are small and flat, they may be operated upon with caustic potassa or ethylate of sodium.

(2) HYPERTROPHIES OF EPIDERMIS AND PAPILLARY LAYERS.

Callositas.—Callosities are those hard, thickened, horny patches of skin of variable size and shape, grayish or yellowish in color, unattended by pain, and which occur for the most part about the hands and feet. They are composed of an increased quantity or growth of the epidermic layer of the skin. They commonly occur at some point where the occupation of the individual gives occasion to unusual pressure and friction, so that in many cases the profession can be known from the locality of the thickening. Occasionally, however, they appear to occur spontaneously.

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[1] See Duhring's Treatise, p. 406.

[2] See a description of the various forms of melanoderma, by Dr. J. C. White; Boston Med. and Surg. Journ., vol. i., 1878.

[1] Dr. L. P. Yandell; American Practitioner, Sept., 1872.

[2] See a remarkable case of multiple nævi, by Dr. J. Nevins Hyde, in the Chicago Med. Journ. and Exam., Oct., 1877.

When the callosity causes pain or inconvenience it is to be removed by means of local measures. The part should be soaked repeatedly in warm water, or macerated by a water-dressing or a poultice, and when it is softened it may be scraped or pared off layer by layer by means of a sharp knife.

Clavus is a small, circumscribed, usually flat, deep-seated, more or less horny formation, painful upon pressure, situated for the most part about the toes. Like the callosity, it is the result of pressure, and this, if continued, may give rise to inflammation. The common seat of the corn is the outer surface of the little toe and the tops of the toes. Occurring between the latter the corn is accompanied by more or less maceration, and is known as a "soft corn." The cause of corns is to be found in ill-fitting or too tight shoes. The growth is made up of a circumscribed, excessive development of the epidermis, and of a central portion or core. The latter extends quite deeply into the tissues, in the form of an inverted cone, the base being directed outwards, and appearing on the surface as a rounded spot. The apex of the cone rests on the papillary layer of the corium. The pain attending corns is produced by the core pressing upon the true skin, causing irritation of the nerve filaments of the papillæ.

The first principle in the treatment of corns is removal of the cause. Tight or badly-fitting shoes must be changed for others, or modified in shape. The next point is the removal of the mass of epidermis. The professional chiropodist prefers to do this while the corn is dry, because then its limits are better defined. Most persons, however, will object to the pain this is apt to cause, and I think it better, in most cases, to first soften the epidermis by means of a poultice, or by covering the corn with a bit of patent lint, soaked in carbonate of sodium, and covered with a piece of oil-silk or wax-paper. The outer layers, being thus macerated, may be removed by picking or scraping with a sharp knife; care being taken not to penetrate and wound the tissues. The corn should be protected from pressure by a plaster of some resinous material, or diachylon plaster, preferably with a hole cut in the centre. The corn plasters of felt in ring-shape, which may be procured in the shops, answer an excellent purpose. Corns which have become inflamed must be cared for assiduously, or they are likely to give much trouble. Perfect rest, for a time at least, is required in these cases, and some soothing application. Poultices of bread-crumb and dilute lead-water, applied cold, exercise a powerful sedative action. Soft corns are best treated by excision, when this is possible. Nitrate of silver in solid stick, glacial acetic acid, flexible collodion, powdered oxide of zinc, or tannic acid, are all useful. The toes should be separated by a thin layer of raw cotton.

VERRUCA.

Verruca or wart presents itself in several different forms. The common wart ordinarily met with on the hands is a small, hard, split-pea sized growth, covered with minute elevations—hypertrophied papillæ, of a color a little darker than that of the skin, or of a yellowish-brown or blackish tint. One or several, or great numbers may exist. Though most frequently met with on the hands, they may be found elsewhere. The flat variety is usually about the size of a finger-nail, and only slightly elevated above the surface of the surrounding skin. It is most apt to be met with among elderly people, and is hence sometimes called *verruca senilis*. The filiform variety assumes the shape of a small, thin, conical, thread-like formation, about the eighth of an inch in length. It is usually met with singly or in small groups about the face, eyelids, and neck. The pointed wart[1] consists of one or more groups of acuminated or irregularly-shaped elevations, usually packed together so as to form a more or less solid mass of vegetations. The individual prominences may be pointed, clubbed, or more or less sessile or pedunculated. In color they are pinkish or reddish, bright red or purplish, depending on their situation and vascularity. They are apt to occur about the genitalia (penis and labia) of both sexes. Upon the penis they generally spring from the glans and inner surface of the prepuce. Upon the female they generally spring from the inner surface of the labia and vagina. They are also found about the anus, mouth, axillæ, umbilicus and toes. About the genitalia their surface is usually moist, and they exhale a disgusting odor due to the decomposition of the secretions on their surface. They grow rapidly, and may attain large size and assume grotesque and misshapen forms.

The causes of warts are obscure. The acuminated variety, on the genitals, are venereal in origin, and are often due to irritating discharges, as in gonorrhœa. *They are never a manifestation of syphilis.*[2]

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[1] Termed also, according to Duhring, moist wart, fig-wart, pointed condyloma, cauliflower excrescence, verruca elevata, or acuminata, venereal wart and vegetation.

[2] The vegetating syphiloderm must not be confounded with the growth under consideration. Its origin, history, and usual appearance will speak against such a view.

The wart is simply an hypertrophy of the papillæ, the connective-tissue element being more prominent in the pointed variety or condyloma.

The treatment of verruca usually is simple. The small wart may be clipped off with curved scissors, and its base touched with nitrate of silver stick. The dermal curette or scraping spoon may also be employed. The ligature, *écraseur*, or galvano-caustic wire may be employed in the larger, vascular variety. Venereal warts about the labia are best treated by washing the parts with dilute liquor sodæ chlorinatæ, and afterwards dusting the surface with powdered calomel. Nitric, chromic, or carbolic acids may be used. A powder composed of equal parts of powdered burnt alum and savin is a very good application. The larger condylomata may be attacked by a Paquelin's cautery. Common warts may be simply cauterized by means of potassa fusa, in stick or solution, nitrate of silver stick, acid nitrate of mercury, chloride of zinc, nitric acid, chromic acid, hydrochloric acid or glacial acetic acid. The potassa caustica should rarely be used in solid form for fear of excessive action. The other applications may have to be made several times. Tincture of the chloride of iron is sometimes used successfully. In using the strong caustics care must be taken to protect the surrounding skin by a layer of wax or other protective. In multiple flat warts a paste of precipitated sulphur, glacial acetic acid and glycerine, equal parts, made at the time of using, may be employed with good results. Hemorrhage should be guarded against in the removal of large masses.

CORNU CUTANEUM.

Cutaneous horns, when fully developed, differ little as regards structure from ordinary horns of animals. The excrescence is solid, hard, dry, and wrinkled, or laminated. In form, it is usually elongated, and roundish or conical. Some-

Fig. 932.

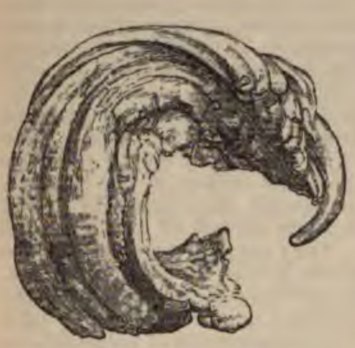
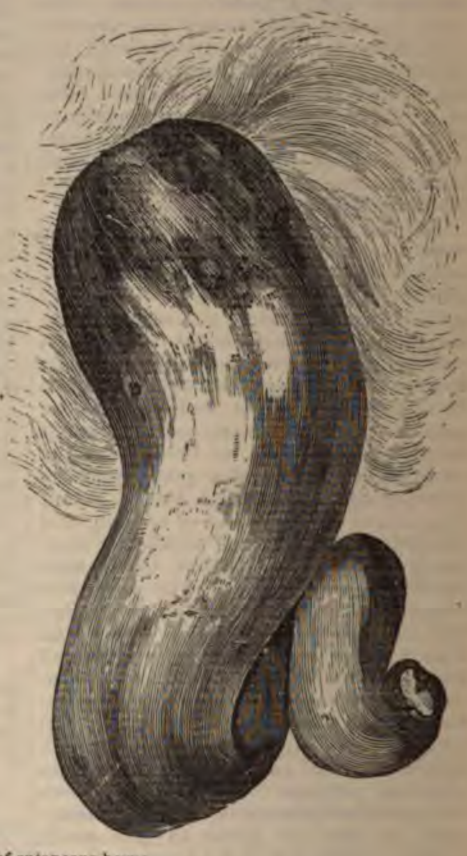


Fig. 933.



Varieties of cutaneous horns

times it assumes a flattened or button-like form. The form is varied, but the horn is often twisted and misshapen. The color is grayish, yellowish, brownish, or blackish. Horns may be of any size from that of a pin's head to that of the finger. The base is concave or flattened, and rests upon the skin, which may be normal or inflamed. Horns are usually single, but may be multiple. They may occur upon any part of the body, but are commoner upon the face. Though commonly occurring upon elderly people, they are also found in the young. They are painless when not injured, and grow slowly, dropping off at times when they have reached a considerable size, and leaving behind a shallow ulcer from which the horn is again reproduced.

The treatment of cutaneous horns is simple. The growth is to be twisted or cut out, and the base lightly cauterized with caustic potassa or chloride of zinc, to prevent its reproduction.[1]

ICHTHYOSIS.

Ichthyosis is a congenital, chronic, hypertrophic disease, usually occupying the whole surface, characterized by dryness, harshness, or scaliness of the skin, and a variable amount of papillary growth. Two varieties of the disease are encountered, ichthyosis simplex, and ichthyosis hystrix. The former may be so mild in form as to amount to little more than a certain dryness and roughness of the skin. It may, on the other hand, be quite severe. As ordinarily met with, ichthyosis simplex consists of an altered state of the skin, characterized by a harsh, dry condition of the whole surface, accompanied by the production of scales, sometimes fine and branny; at other times coarser, and shaped after the lines and furrows of the skin. The latter from their resemblance to fish scales have given occasion to the name of the disease, "ichthyosis" or the "fish-skin" disease."[2] The amount of scales depends upon the age of the patient, the severity of the disease, and the efficiency of any treatment which may have been employed. The scales, if not removed by bathing, often tend to accumulate. They are usually whitish, grayish, or yellowish in color, with sometimes a silvery glistening look. Sometimes the general color of the eruption is of a more or less yellowish or dark olive-green. Even when the disease is not severe, it gives the surface an unwashed look.

Ichthyosis hystrix is characterized by the formation of irregularly-shaped and sized, ill-defined, rough, harsh, yellowish, brownish, or greenish patches, made up of enormously hypertrophied, more or less horny papillæ. Unlike the other form of ichthyosis, this is apt to be localized, and rarely covers the surface to any extent. It is sometimes distributed in the line of the nerves. Sometimes the papillæ are so hypertrophied as to stand out like porcupine quills—hence the name, "hystrix."

The commonest seats of ichthyosis simplex, or rather the localities where it is commonly most markedly developed, are the lower extremities from the hips to the ankles, and the arms and forearms. The skin of the backs of the hands and the face very often has a peculiar smooth drawn parchment-like appearance, which is very characteristic. Sensible perspiration is in most cases absent, except in the axillæ, face, palms, and soles. The disease is worse in winter than in summer; in fact, it is apt to almost disappear during the latter season. The course of the disease is essentially chronic. Beginning to show itself distinctly during early childhood, it grows more and more marked with each year of the patient's life. It sometimes appears to be hereditary, but no distinct and invariable hereditary influence seems to prevail in all cases. Ichthyotic persons usually beget healthy children. The patients generally enjoy good health. The disease occurs in all races, both sexes, and in every grade of society. It is a rare disease. The statistics of the American Dermatological Association show only 36 cases of ichthyosis, in 16,863 cases of general skin-disease, but, as Duhring remarks, the affection is probably more frequent than would appear from these figures.

The diagnosis of ichthyosis is usually not difficult. The history will usually separate the affection from all others, its chronicity offering a marked contrast to the rapidly developing character of the acute-inflammatory disorders.

External treatment alone has been found useful in ichthyosis. The skin is to be kept moist and supple by the frequent administration of warm baths with soap. Even soft soap or sapo viridis may be employed. After the bath, inunctions may be practised with glycerine and water, or with the following:—

℞. Adipis benzoatæ, ℥ij.
Glycerinæ, ♏xij.
Ung. Petrolei, ℥ss. M.

Fiat unguent. Sig. Apply daily after washing.

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[1] A number of references to cases and monographs on the subject of cutaneous horns will be found in Duhring's Treatise, p. 358.

[2] An excellent portrait of the affection is given in Plate F, of Duhring's Atlas.

I have used the following formula with satisfaction. I have been unable to understand what part, if any, the iodide plays in the therapeutic effects of the remedy:—

℞. Potassii iodidi, ℈j.
Olei pedis bubuli,
Adipis, āā, ℥ss.
Glycerinæ, fʒj. M.
Fiat unguent.

The hystrix variety may sometimes be attacked with the knife when necessary.

The prognosis of ichthyosis is entirely unfavorable as regards permanent cure, but the alleviation of the symptoms may be brought about very satisfactorily. The affection may be regarded really as a deformity rather than a disease.

Keratosis pilaris is somewhat akin to ichthyosis; it is characterized by the formation of pin-head sized, conical, whitish, epidermic elevations seated about the apertures of the hair follicles, chiefly those of the outer aspect of the thighs and arms. It looks not unlike "goose flesh." The treatment is the same as that of ichthyosis, but the prognosis is more favorable.

(3) HYPERTROPHIES OF CONNECTIVE TISSUE.

SCLERODERMA.[1]

Scleroderma is an acute or chronic disease characterized by a diffuse, more or less pigmented, rigid, stiffened, or hardened hide-bound condition of the skin. The disease begins by a more or less marked stiffening or hardening of the skin over a greater or less area, which increases until the part affected becomes completely sclerosed. The process may be rapid, or it may take weeks or months to reach its height. It is usually unaccompanied by subjective symptoms, excepting such as are produced on the parts adjacent by the mechanical changes in the skin. When fully developed, the skin is stiff, rigid, immovable, firm, and hard to the touch, the part seeming as if frozen or carved out of wood. The skin is bound to the tissues beneath, so that it cannot be made to glide over them, nor can it be pinched up into folds. Sensation, the perspiratory and sebaceous secretions, and the hairy growth are usually normal.

The disease commonly affects a considerable area, and melts insensibly into the surrounding healthy skin. Though it may attack any region, it is most frequently encountered about the neck, where it often begins, and on the shoulders, back, chest, arms, and face. Occurring on the latter, a peculiar wooden expressionless appearance is presented, which is highly characteristic. If the hands are attacked they become crooked and claw-like, and small ulcers sometimes form over the knuckles where the skin is most tense.

The course of the disease is variable; sometimes it undergoes spontaneous involution, in other cases it may last a lifetime.[1] Death has been reported from inanition, the disease having rendered the jaws immovable. The general health is good, excepting that rheumatism is a frequent concomitant.

The etiology of scleroderma is exceedingly obscure. Exposure to cold and dampness has been oftenest referred to as a cause. The disease is commonest in early adult and middle age. It is extremely rare.

Treatment in many cases appears to have little or no effect. Cases have recovered, however, under the use of arsenic, quinia, cod-liver oil, with frictions, massage, baths, and inunctions. Electricity has also been employed with apparent success, but there was room for question in each case whether the disease had not undergone spontaneous evolution.

MORPHŒA.[2]

Morphœa in its usual form begins by the development of one or more roundish or irregular hyperæmic patches the size of a small or large coin. They soon become well-defined and circumscribed, and surrounded by a faint or distinct pinkish-violet, or lilac border or areola, several lines in width, made up of very minute capillaries. When fully developed the morphœic patch resembles a plate of ivory let into the skin, having a lardaceous or waxy appearance. It may be quite natural to the touch, or rather brawny and leathery.

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[1] The reader is referred for a full description of this affection to the article in Dr. Duhring's Treatise (p.369), by far the clearest and most exact account of the disease which we possess. The opinions of dermatologists as to the limits between scleroderma and certain other affections, as morphœa and linear atrophy, differ considerably, and in the present state of our knowledge this is not surprising. The space allotted to the present article only permits a general description of scleroderma, and of course precludes the discussion of obscure or mooted points.

[1] A characteristic case reported by me eight years ago (Am. Journ. Syphilography and Dermatology, Oct., 1873) had not changed when last heard from after six years.

[2] A full description of this affection is given by Duhring, loc. cit., p. 376.

There is usually a brownish areola around the patch. The lesions may develop to the size of the palm, and they may occur on any part of the body. As a rule they are not accompanied by any subjective sensations. Having reached their full proportions, the lesions may remain stationary for months or years, and then undergo more or less rapid spontaneous evolution, or in other cases undergo atrophic changes, the skin becoming contracted, then parchment-like or shriveled, and later bound to the tissues beneath, forming large or small, rounded or elongated cicatriciform lesions, causing contraction and disfigurement. The subcutaneous and even muscular tissues may become wasted and shrunken, giving rise to deformity, and in the case of a limb to loss of power.

Various other forms of the disease occur, some inclining toward the characters of macular and linear atrophy, others verging toward scleroderma, and the affection is at times a very puzzling one to define and distinguish. The disease is rare, but not so rare as scleroderma. Its cause is not known. The treatment should be tonic and alterative. Dr. Duhring, whose experience with this affection is unusually extensive, says that more benefit may be gained from the judicious use of arsenic than from any other remedy. Electricity may also be employed.

Unilateral atrophy of the face may be mentioned here. The disease is remotely allied to morphœa and scleroderma. It consists in a variable degree of atrophy of part or the whole of one side of the face, involving the skin, subcutaneous connective-tissue, and deeper structures, including in some cases even the bones. The changes which take place in the skin are in Duhring's opinion of the same nature as those which occur in the characteristic lesions of morphœa met with in other regions. The neurotic condition is so evident that the disease has received most attention at the hands of neurologists.[1]

SCLEREMA NEONATORUM.

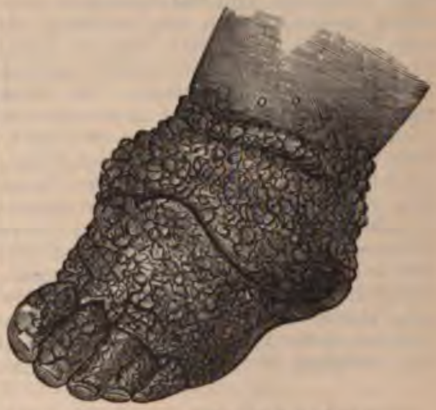
Sclerema neonatorum is a disease of infancy, appearing usually at birth, consisting of a diffused stiffness and hardness of the cutaneous and subcutaneous tissues, accompanied by coldness, œdema, swelling, discoloration, lividity, and general circulatory disturbance. The disease may be congenital, or may appear during early infancy; it is commoner among premature children. It usually begins in the lower extremities and extends upwards. The skin is mottled, stretched, tense, indurated, and like marble. The surface is cold, especially about the legs. There is more or less œdema. The appearance of the infant is like that of a frozen corpse. The child is unable to move, takes little nourishment, respires feebly, and usually sinks and dies in a few days. Very rarely spontaneous recovery takes place. Treatment should be directed against the general condition.

ELEPHANTIASIS.

Elephantiasis is a chronic hypertrophic disease of the skin and subcutaneous connective-tissue, characterized by enlargement and deformity of the part affected, accompanied by lymphangitis, swelling, œdema, thickening, induration, pigmentation, and papillary growth.

The affection usually begins by an attack like erysipelas, with lymphangitis, pain, and fever, followed by slight enlargement of the part. Similar attacks subsequently occur from time to time, the limb or region involved being slightly increased in size upon each occasion. At the end of a year or more, after a number of these attacks have taken place, the part is usually found to have increased considerably in size; to be chronically swollen, œdematous, and hard. In the limbs, the leg particularly, not only will the entire member be found enlarged, but the skin itself decidedly hypertrophied, as shown by the prominent papillæ, fissures, and more or less discoloration and pigmentation. The process usually goes on until very considerable deformity results.

Fig. 934.



Elephantiasis of the foot and leg.

The appearance of the disease varies in

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[1] See references given by Duhring, loc. cit., p. 382.

one part or another of the body. The commonest seat of the disease is in the leg (fig. 934), one limb alone being generally attacked. The genitalia are next in point of frequency attacked. Other regions are more rarely assailed.

The amount of pain attending the disease varies; it is sometimes severe during the inflammatory attacks, while at other times and in other cases no pain is felt. The increased weight of the part, as in the case of the scrotum or leg, may interfere with locomotion.

Elephantiasis is found in all parts of the world, but is more frequent, and, in fact, is endemic in certain tropical climates, as the West Indies, South America, India, China, Japan, Egypt, etc. Arabia and Africa furnish the largest number of cases. The question of the causes of the disease is one of great interest. Climatic conditions have a certain amount of accountability for its production, but late investigations by Lewis, Manson, and Bancroft[1] point to occlusion and inflammation of the lymph-channels caused by a parasite, the "filaria sanguinis hominis." Certain it is that these parasites are frequently present in "lymph-scrotum," an affection closely allied to elephantiasis. The question of the identity of these diseases, though maintained by some, has not yet been satisfactorily proved. Dr. Manson thinks that the mosquito plays a part as intermediary in spreading the disease. It is found among the lower classes and those living under bad hygienic circumstances.

The treatment of elephantiasis may be medicinal or surgical. During an inflammatory attack, rest, with cold or hot applications, and local sedatives, are called for. After the pain and heat have subsided, inunction with ung. hydrarg. or ung. hydrarg. ammoniat. may be practised, and the limb is then to be encased in a closely-fitting bandage. The solid rubber bandage alone, or in connection with other remedies, may be employed. This treatment, with rest, is the most appropriate, and should be persevered in as long as it seems to do good. Internally quinine may be given during the exacerbations, with a view of quelling the fever. Iodide of potassium has also been recommended. Change of climate is said to do good at times. Ligation of the main artery supplying the limb has been tried, but, excepting in the hands of its originator, Dr. Carnochan, of New York, with equivocal success.[1]

When the genitalia are involved amputation offers the best means of relief. Osgood[2] states that of sixty cases operated upon in China during the past fifteen years all recovered. Fayrer,[3] on the other hand, states that of one hundred and ninety-three cases operated on in the Medical College Hospital in Calcutta, between 1859 and 1871, eighteen per cent. proved fatal.

The prognosis of elephantiasis once fully developed is unfavorable as regards entire cure. Much may be done, however, in the earlier stages of the disease, to arrest its progress. Great deformity attends the disease, the "elephant leg" being a favorite and striking illustration in works on surgery of this affection, so little likely to be mistaken for any other. Elephantiasis rarely terminates fatally, though it is said that a fatal result may in rare cases follow an inflammatory attack.

DERMATOLYSIS.

Dermatolysis consists of a more or less circumscribed hypertrophy of the cutaneous and subcutaneous structures, characterized by softness and looseness of the skin, and a tendency to hang in folds. It is a rare and very striking affection, and may occur over various parts of the body, sometimes developing to an enormous size, as in Nélaton's case, reported by Keen.[4]

The treatment is removal by the knife.

HYPERTROPHY OF THE HAIR.

Hypertrophy of the hair (Hirsuties) includes all those cases in which the hairs are unusually developed as regards their size and number, either upon regions where the hair is ordinarily found, or in places where the hair is abnormal. Duhring (loc. citat., p. 391) quotes a number of cases of extreme length and abundance of hairy growth of the scalp and beard. When hairs in excess occur in connection with moles, the condition is termed *nævus pilosus;* while, occurring on a rough, uneven, warty surface, it is called *nævus verrucosus*. *Trichiasis* is the abnormality of direction of the hairs; it may occur anywhere, but when found on the eyelids the hairs turning inward sometimes give rise to great irritation of the ball. *Plica polonica*, formerly common in Poland, and observed among the low and filthy Jews chiefly, is a matted and tangled condition of the long and neglected hair, glued together by discharges from the scalp irritated by lice. It is not a disease *sui generis*, but is practically aggravated lousiness. I have had patients express the fear that they were the victims of this disease, and have even heard the diagnosis made by physicians, but I venture to say that no case of true plica polonica has ever occurred in this soap-and-water-ridden country since the arrival of the settlers at Jamestown. The treatment is simple in the slight and modified cases sometimes known under this name. The hair is to be cut short, parasiticide remedies applied (see pediculosis capitis), and cleanliness persevered in.

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[1] See articles by Fayrer, Lancet, Feb. 8 and 15, 1879; Manson, Med. Times and Gaz., Nov. 13 and 20, 1875; and Chinese Customs Medical Reports, xiii., 30; xiv., 1. Shanghai Reprint. Also Busey, Congenital Occlusion and Dilatation of Lymph Channels, New York, 1878.

[1] Werner (Deutsche Zeitschr. f. Chir., 1876) gives an analysis of the results of this treatment in thirty-two cases, the femoral being the artery in twenty-three cases. Permanent success was gained in only three cases. In four cases, where compression of the artery was employed, equally good success was obtained.

[2] On the Treatment of Elephantiasis, with a table of fifty cases. New York Med. Record, April 8, 1876.

[3] Lancet, March 29, 1879.

[4] Photographic Review of Med. and Surg., vol. ii., p. 45. Other interesting cases have been reported by Valentine Mott (Med.-Chir. Soc. Trans., vol. xxxvi., p. 155); Bell (Principles of Surgery, vol. iii., London, 1808); Fritsche (Trans. Clin. Soc., London, 1873. The portrait is given in Tilbury Fox's Atlas of Skin-Diseases). Stokes (Dublin Journ. Med. Sci., Jan., 1876).

The removal of abnormal growths of hair occurring in normally hairless regions is an operation requiring considerable skill. It is best done by means of electrolysis, as recommended by Michel,[1] Hardaway,[2] Piffard,[3] and Fox.[4] The operation, which is simple and safe, consists essentially in the introduction of a fine needle into the hair-follicle, and the destruction of the hair-papilla by means of the galvanic current. The best description of the process is given by Dr. Hardaway, who first used it. All other methods of removing superfluous hairs are failures. Depilatories are temporary, vain, and futile.

Class V.—ATROPHIES.

Vitiligo.

Vitiligo is an acquired disease, consisting of one or more usually sharply-defined, rounded, ovalish, or irregularly shaped, variously sized and distributed, smooth, whitish spots, whose borders usually show an increase in the normal amount of pigmentation. The number of spots is not usually numerous; they are smooth, on a level with the surrounding skin, and, save for the discoloration, indistinguishable from it. In size the spots vary from that of a coin to that of the palm, or larger. They are roundish, and as they grow larger tend to coalesce. Their color is milky-white, owing to the absence of the normal pigment of the skin. Hairs growing on the diseased areas may or may not be whitened. The sebaceous and perspiratory secretions are unchanged. Sensation is normal; there is neither itching, pain, nor anæsthesia. The increased coloration of the skin in the neighborhood of the diseased patches is a constant feature. It is more intense in the immediate neighborhood of the spots, and fades away gradually from this point.

The disease may occur on any part of the body, and at any time of life. It is common upon the backs of the hands and the trunk. The disease is striking and disfiguring.[1] Although it occasionally disappears after some years, it is more apt to be very chronic, and may last a lifetime. It is sometimes met with in connection with other diseases of the skin, as Addison's disease, alopecia areata, and morphœa.

The diagnosis of vitiligo is not difficult if its characteristic features are borne in mind. It is sometimes confounded with chloasma, but a careful examination will show that the patches of the latter are yellowish or brownish, and the surrounding skin of a normal color; while in vitiligo it is the skin of the diseased patches which is white, and the surrounding skin darker than is normal. The same holds good of tinea versicolor, only that the patches of this disease are not only yellowish or brownish, as in chloasma, but they are also covered with furfuraceous scales. The microscope likewise aids, inasmuch as the fungus of T. versicolor may thus be detected when that affection is present. Morphœa is so unlike in its essential features that only careless observation can confound it with vitiligo.

The treatment of vitiligo is to be directed against such general symptoms as may be present. Arsenic sometimes seems to do good. The galvanic current may also be employed, but treatment is, on the whole, unsatisfactory.

Atrophia Cutis.

Atrophy may affect the skin, either in the form of a diminution of its bulk, or by a degeneration of its elements. In the first case the skin is thin, dried, and shriveled. In the second case structural alteration takes place, with or without actual loss of substance. The tissue so affected is somewhat hardened, yellowish or whitish in color, and has a waxy, fatty, bacony look. Atrophy of the skin may be general, as in senile atrophy and in certain rare forms of disease; or it may be partial or limited, as in atrophic lines or spots in morphœa.[1]

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[1] St. Louis Courier of Medicine, Feb., 1877.

[2] Trans. Am. Derm. Association, 1878 and 1880; also Phila. Med. Times, Feb. 14, 1880.

[3] Diseases of the Skin, p. 307, New York, 1876, and Therapeutics of Skin-Diseases, New York, 1881.

[4] New York Med. Record, March 22, 1879.

[1] See Plate M, Duhring's Atlas.

The disease known as "xeroderma of Hebra," and more recently described by Dr. R. W. Taylor as "angioma pigmentosum et atrophicum," and also by Dr. Duhring, consists essentially in the presence at first of numerous disseminated, pin-head-sized to split-pea-sized, yellowish, brownish, or blackish pigmentary spots resembling freckles. These are succeeded by numerous minute telangiectases occurring among the freckles, and finally the development of numerous small atrophic spots.

Allied to these is Dr. I. E. Atkinson's case of "unilateral idiopathic cutaneous atrophy," affecting a large portion of the left abdomen, flank, and leg, with pigmentation and hypertrophy of the cutaneous capillaries.[2]

ATROPHIC LINES AND SPOTS.—This form of atrophy may be either idiopathic or symptomatic. In the first case it comes without apparent cause, the patient's attention often being attracted to the lesions only by accident, and after they have existed for some time.
(*striæ atrophicæ*) are usually an
one-quarter of an inch in dian
one to several inches in length;
(*maculæ atrophicæ*) are roundis
ish, and from a pin-head to a pe
nail size. Both lesions present
glistening scar-like appearance
ceptibly thinned to the touch
depressed, or grooved, and sho
liar mother-of-pearl lustre.
are usually found in number
parallel to one another and in
direction. The spots are gen
lated. They may occur on a
the body, but are usually found
tocks, trochanters, pelvis, an
thighs, upon both extensor
surfaces. They run a slow c
give rise to no inconvenienc
cause is obscure; they are
found in connection with morp

Symptomatic atrophy of th
sults from distension, as in
tumors, etc. The best exam
form is found in the so-called
bicantes." According to San
lines are not caused by rupt
connective-tissue bundles as for
posed, but by stretching.

ALOPECIA.

Alopecia is a condition of m
complete baldness, resulting fr
cient growth of the hair, irres
cause. The varieties, however,
nated according to the causes w
occasioned the disorder; and a
view to expressing their chief
istic.

Congenital alopecia is the nam
those rare forms of the disease
individual is born without hair.
gives such a case where micr
amination of the scalp showe
of hair-bulbs. I am familiar wi
of an otherwise healthy inf
whose scalp only lanugo grew
the third year. A hereditary
tion to scanty growth or ear
hair may often be traced.

Senile alopecia or the baldness
is connected with the general
the cutaneous tissues which occ
period of life. The hairs bec
thin, and dry, and are cast off
renewed. This form of baldne
moner among men than amon
for what reason is unknown.
of the body generally become th
drop out, to a less extent, at the

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[1] Duhring (loc. citat., p. 404 et seq.) gives description and references to the various forms of atrophy of the skin, some dependent upon or resultant from other diseases, and some due to nerve changes. "Glossy skin" and the affection known as "xeroderma of Hebra," or "Angioma pigmentosum et atrophicum," also come under this head. See S. Weir Mitchell, Injuries of Nerves and their Consequences, Philadelphia, 1872; Paget, Medical Times and Gazette, March 24, 1864; Mitchell, Morehouse, and Keen, Gunshot Wounds and other Injuries of the Nerves, Philadelphia, 1864; Balmer, Archiv der Heilkunde, 1875, p. 327; Erasmus Wilson, Lectures on Dermatology, London, 1878. (The latter a very curious case of general atrophy of the skin over the whole body). Glax (Viertelj. für Derm. u. Syph., Heft. 1, 1874, Abst. in Archives of Dermatology, vol. i., No. 3), and Geber (Allg. Wiener Med. Ztng., No. 35, 1874, Abst. in Viertelj. für Derm. u. Syph., Heft. 1, 1875, p. 114), are similar to Wilson's, but in the latter case with a resemblance to morphœa. The references to "xeroderma of Hebra" are R. W. Taylor, Trans. Am. Derm. Association, 1878, and Duhring, Am. Journ. Med. Sci., Oct., 1878.

[2] Richmond and Louisville Med. Journ., Dec., 1877.

[1] K K. Gesellsch. der Aertzte
London Med. Record, April 15, 188

[2] Archiv f. Klin Chir., Bd. xiv.

Idiopathic premature alopecia, or premature baldness, may take place either rapidly, in the course of weeks or months, or, as is most generally the case, slowly, through a period of years. The hair may begin to come out at any period after puberty, although it does not generally fall much before the age of twenty-five to thirty. The scalp is healthy to all appearance, no seborrhœa being present. At first only a few hairs fall, and these are succeeded by new ones growing from the same follicles, but coming earlier to maturity and falling out before they have attained a normal length. The process is progressive, more and more hairs falling prematurely. Each new crop of hairs is shorter and finer than the preceding, until finally only lanugo or short, fine, soft, woolly hairs are produced. In the course of time even these are no longer produced; the hair-follicles become atrophied, and complete baldness ensues. The process is sometimes arrested, and normal hairs may be produced for a time, but the improvement is apt to be transitory.

This form of alopecia is very common; it is more frequent among men than among women; as in senile alopecia, it ordinarily begins about the vertex and extends toward the forehead.[1]

Symptomatic premature alopecia includes three forms of more or less complete baldness, caused by local or general diseases. The loss of hair may be temporary or permanent. Fevers, nervous disorders, violent shocks to the nervous system, and mental distress may give rise to sudden or gradual loss of hair. Local affections, particularly those attacking the follicles, as seborrhœa sicca, and lupus erythematosus, may give rise to baldness, generalized or in patches, which may be permanent. When baldness results from erysipelas, psoriasis, eczema, or variola, the hair is apt to return again after the disease has passed away, and with the recovery of the general health. Syphilis and leprosy also occasion alopecia. In syphilis, the loss of hair occurs in the first general outbreak, just as in other fevers; it is then usually reproduced. Later in the history of the disease it occurs in consequence of local lesions, and when these are ulcerative, the hair does not grow again.

The remedies used in alopecia must depend upon the exciting cause and circumstances of the disease. In premature alopecia stimulating local remedies, such as will be mentioned later under alopecia areata, may be used. In alopecia following fevers, a tonic treatment is called for. Syphilitic alopecia of course demands specific treatment, and senile alopecia cannot be remedied. The treatment of alopecia due to seborrhœa and to parasites will be found mentioned under these headings.

ALOPECIA AREATA.

Alopecia areata is an atrophic disease of the hair-system, characterized by the usually sudden appearance of one or more circumscribed, whitish bald patches, varying in size and shape, or of more or less universal baldness. Alopecia areata may attack any portion of the hairy surface. Its commonest seat is the scalp, the other regions being rarely invaded. At times, however, the whole surface may be involved. A number of such cases have come under my observation; among others, those of a mother and daughter, respectively thirty and fifty years of age, both of whom showed complete absence of hair from the scalp, pubes, and axilla of some years' standing. Upon the scalp the disease is usually observed to consist of one or several patches of baldness,[1] roundish, sharply circumscribed, and conspicuous. They may vary in size from a small coin to the palm of the hand. The baldness is generally complete, the area presenting a whitish, perfectly smooth, polished surface, often without a trace of hair. Less frequently a thin growth of hair persists over the nearly bald areas. A growth of lanugo often occurs in the course of the disease; but, unless a cure is about to be attained, the fine downy hairs drop out again after a short time, and the patch is as bald as before. The skin is slightly or not at all altered, excepting that the hair-follicles gradually atrophy.

The course of the disease is variable; in some cases the hair thins out slowly, in other instances a handful of hair may come out in a single night, leaving a fully developed patch. The ultimate size of the area is soon reached, and it usually grows no larger. When several patches exist, they usually form one after another, and one may be recovering while another is forming. The disease may continue weeks or months; its course is very variable. Relapses are not uncommon, but when complete repair sets in recovery is usually rapid. The new hair is sometimes pale, gray, or mixed in color. There are no subjective symptoms as a general thing, but patients sometimes notice a premonitory itching or soreness.

The causes which produce the disease

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[1] The whole subject of the reproduction and fall of the hair has been studied by Pincus with great assiduity and thoroughness. See Virchow's Archiv, cited further on, and the Berlin. Klin. Wochens., Nos. 4 and 5, 1875.

[1] See Duhring's Atlas, Plate N.

are not understood. It is non-parasitic in its nature, and is not contagious. Its origin is, I think, to be found in some functional nerve disturbance causing impaired nutrition. It has been noted to follow neuralgias, sudden nervous shocks, and debility resulting from various causes. In many cases, however, patients enjoy excellent health, and no appreciable cause for the attack can be assigned. The pathology of the disease is of interest as pointing to the proper treatment to be pursued. Though numerous attempts have been made of late years to assign a parasitic origin to the disease, these have failed to bring conviction to the minds of dermatologists in general. The subject has been very thoroughly, and, I think, so far as our present knowledge goes, satisfactorily settled in the negative, by Drs. Duhring[1] and Dyce-Duckworth.[2]

With regard to the diagnosis of alopecia areata, the disease is more apt to be mistaken for tinea tonsurans than for anything else. The suddenness of the attack, however, the more or less complete baldness, the absence of desquamation, the whiteness and remarkable smoothness of the patch, always enable it to be distinguished from tinea tonsurans. Difficulty can only arise in old cases of tinea when the short characteristic hairs have disappeared, but even here more or less desquamation exists. Tinea tonsurans begins as a small patch and spreads slowly; there are always or almost invariably a certain number of nibbled-looking, broken-off hairs in the patch, and there is a history of contagion. The microscope, revealing the characteristic fungus (see under tinea tricophytina) will settle the matter, and should always be employed in cases of doubt.

The treatment of alopecia areata, like that of most diseases which are stubborn, is varied, and the medicines which have been recommended are very numerous. Many remedies which have been greatly vaunted have gained only an apparent success, due to the fact that a certain number of cases of alopecia areata tend to spontaneous recovery. Usually both internal and external remedies are called for. The ordinary tonics, iron, quinine, and arsenic, to which may be added strychnia and phosphorus, are the remedies commonly to be relied upon. A certain number of patients require cod-liver oil. There are few skin-affections where the skill of the practitioner in general treatment is more demanded. Often the patient's general health appears to be perfect, and only after long and careful search can the weak point be found to which the failure in nutritive power is to be attributed. Occasionally the minutest examination will fail to yield any evidence of disturbance of the normal equilibrium of the system. Treatment must then be purely empirical. Hygiene is always of importance.

The external remedies which have been found useful, or which have been thought to be of use in alopecia areata, are all directed with a view to one single object, namely, to stimulate the skin and to cause a more active flow of blood to the affected parts. Alcohol, cantharides, the essential oils, glycerine, castor oil, carbolic acid, tar, iodine, turpentine, ammonia, salts of mercury, veratria, acetic acid, tannic acid, nux vomica, pepper and sulphur are the remedies which Duhring gives as among the most valuable. To these I may add kerosene oil and crude petroleum, which, though not agreeable, are certainly useful local applications in some cases. These remedies may be applied in the form either of ointments or lotions, in sufficient strength to produce a stimulant or rubefacient effect once or twice daily, as occasion may require. As a preparation, before making any of the ordinary applications, the scalp may be washed with Castile soap and water, or with the spiritus saponis kalinus, the formula for which may be found under the head of eczema. After washing, the scalp is to be dried with a coarse towel and brushed with a stiff brush until moderately stimulated. Patients sometimes express fears lest the local applications will produce a greater amount of baldness, but it will be found that, after the patches have formed, the remaining hairs are firmly seated. The following are some of the formulæ which will be found most generally useful:—

℞. Acidi carbolici, fʒss.
Alcoholis, f℥j, fʒvj.
Olei ricini, f℥ij.
Olei amygdalæ amari, gtt. x. M.

Cantharides, in the form of an ointment, is sometimes used. The strength should be one to three drachms to the ounce. The following is a cantharidal lotion often found advantageous:—

℞. Tinct. cantharidis,
Tinct. capsici, āā f℥iss.
Olei ricini, f℥ij.
Aquæ Cologniensis, f℥j. M.

Wilson recommends the following formula, which I have sometimes used with satisfaction:—

℞. Olei amygdalæ dulcis, f℥j.
Liquoris ammoniæ fort., f℥j.
Spiritus rorismarini, fʒv.
Olei limonis, fʒj. M.

Wilson also recommends frictions with a liniment of camphor, ammonia, chloroform and aconite. Oil of turpentine, brushed into the patches with a stiff brush once or twice a day, until the scalp becomes sensitive, is recommended by Dyce-Duckworth. Tilbury Fox recommends the following lotion, which I have employed more extensively than any other, and with generally satisfactory results:—

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[1] Amer. Journ. Med. Sci., July, 1870.

[2] St. Bartholomew's Hosp. Reports, vol. viii.

℞. Tinct. nucis vomicæ, f℥ss.
Tinct. cantharidis, fʒvj.
Glycerinæ, f℥ij.
Aceti destillati, f℥iss.
Aquæ rosæ, ı℥iij. M.

Blistering the surface with cantharidal collodion has sometimes been tried with success; I have never employed this treatment. Electricity also is recommended, and appears to be well worth atrial.

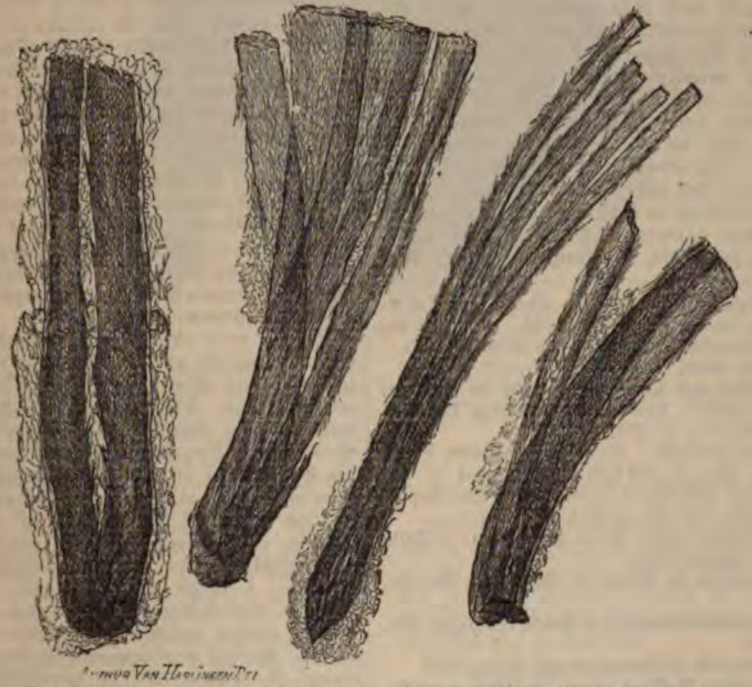
The prognosis of alopecia areata should be guarded. Sometimes recovery takes place in a few months; in other cases it may be delayed for years. Now and then the hair is not restored at all. As a rule in young persons the baldness is not permanent. Treatment should be persevered in.

ATROPHY OF THE HAIR.

Atrophic changes in the structure of the hair take place as the result of disease, as seborrhœa, and also as the result of impaired nutrition following disease, as syphilis, fevers, etc. Idiopathic atrophy, independent of disease in other structures, also occurs in the following-named rare affections:—

FRAGILITAS CRINIUM, a fragility of the hair, is marked by a brittle condition of the hair-shaft, which is uneven, thinner at one point than another, the free ends tending to split up into brush-like terminations. Duhring has described a form of fragilitas crinium,[1] characterized by marked atrophy of the hair-bulb and splitting of the hair-substance, the fissure taking place within the follicle and producing irritation of the skin. (See fig. 935.)

Fig. 935.



Specimens of atrophic hair, showing the several varieties of the disease (Duhring).

TRICHOREXIS NODOSA.—This form of fragilitas crinium consists in the formation of a series of small, spindle-shaped, bulbous swellings, situated at irregular intervals along the shaft of the hair. They are met with chiefly upon the beard and moustache, but also on the scalp and elsewhere more rarely. The hairs burst at the point of distension, leaving bristly stumps looking as if two stubby paint-brushes had been jammed end to end.

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[1] In a paper read before the American Dermatological Association, in 1877, and published in the American Journal of the Medical Sciences, July, 1878.

The affection was first described by Beigel,[1] and more recently by Kaposi.[2] Devergie,[3] Billi,[4] Roeser,[5] Schwimmer,[6] and Sherwell,[7] have also described cases. W. G. Smith, of Dublin,[8] has described an unusual form of the disease where the bursting took place *between* the nodose swellings.

Piedra.—Desenne[9] and Morris[10] have described a condition of the hair consisting of small nodosities surrounding or on one side of the hair, hard and gritty in character, and which these observers regard as a fungous growth. Under the microscope the nodes are seen to consist of a honey-combed mass of pigmented spore-like bodies. Similar cases have been reported by Beigel[11] and by Hoggan.[12]

ATROPHY OF THE NAIL.

Atrophy of the nail is an affection scarcely worthy of note were it not for the fact that it may be mistaken for, clinically and therapeutically, more important parasitic and other affections attacking this appendage of the skin. The nail is usually smaller or thinner than normal; or brittle and split; or soft and crumbly, according to the cause. The color may be pale, whitish, opaque, or dark. The so-called "worm-eaten" condition of the nail due to various causes, is, according to Duhring, generally of an atrophic nature. Injuries, syphilis, eczema, psoriasis, and fungous disease may attack the nail. They are to be distinguished from the idiopathic form of atrophy, the latter being usually incurable.

CLASS VI.—NEW GROWTHS.

KELOID.

Keloid is a connective-tissue new growth, characterized by one or more irregularly shaped, variously sized, elevated, smooth, firm, somewhat elastic, pale-reddish, cicatriciform lesions.

The disease usually begins as a small pea-sized nodule, increases slowly in size, and commonly assumes an ovalish elongated or crab-shaped form, or may occur in streaks or lines. The lesion varies greatly in shape, and may be quite small or as large as the palm. The outline is well defined, and the surface contour rounded and highest in the centre. Taken between the fingers it has a firm, dense, slightly elastic feel. Its surface is smooth, shining, and generally devoid of hair, and its color reddish or pinkish. The lesion is usually single, though several may exist simultaneously. It is more common over the sternum, but it is also met with on the mammæ, neck, ears, arms, and elsewhere. It is sometimes painful, especially on pressure, and occasionally, but rarely, it itches. The course of the disease may be rapid or slow; having attained a certain growth, it is apt to be stationary, and may remain a lifetime, though it generally disappears spontaneously.

Keloid may arise spontaneously, or it may spring up at the site of various injuries of the skin, when it is called *cicatricial keloid*. This variety is often met with as the result of burns by fire or chemicals, cuts, flogging, and wounds of all kinds.[1] It is sometimes found in the lobe of the ear after piercing for earrings, in the scars of leech bites or of acne lesions, and I have seen it abundantly developed in the scars of non-parasitic sycosis. I think in these last two instances the keloid lesions tend to disappear rather more rapidly than in other forms. Keloid is commoner in the colored race. No cause can be ascribed for the spontaneous variety, and I am myself inclined to believe that it does not in reality exist; each lesion of keloid being seated in some previously existing scar which, however, may have been so minute as to have escaped notice.

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[1] Sitzungsbericht der k. Akad. der Wissenschaft, bd. xvii., p. 612, 1855. Also, in his little popular work "On the Human Hair." London, 1869.

[2] Hebra and Kaposi. Treatise on Diseases of the Skin. New Sydenham Soc. Translation, vol. iii., p. 244.

[3] Tricoptilosis. Annales de Derm. et de Syph., No. 1, 1871–2. Translated in the American Journal of Dermatology and Syphilography, vol. iii., p. 254.

[4] Giornale Ital. della Mal. Ven. e della Pelli, August, 1872.

[5] Annales de Derm. et de Syph., No. iii., 1878.

[6] Vierteljahresschr. f. Derm u. Syph., Hft. 4, 1878.

[7] Archives of Dermatology, July, 1879.

[8] British Medical Journal, May 1, 1880. Also, in a paper read before the American Dermatological Association at Newport, 1880. See Archives of Dermatology, April, 1881.

[9] Comptes Rendus, July, 1878 (see T. C. Fox, Lancet, Dec. 7, 1878, p. 804, with a woodcut).

[10] Lancet. March 22, 1879. p. 407; also Cheadle and Morris, Lancet, Feb. 8, 1879, p. 190 (with woodcut).

[11] The Human Hair, London, 1869.

[12] Lancet, Sept. 7, 1878.

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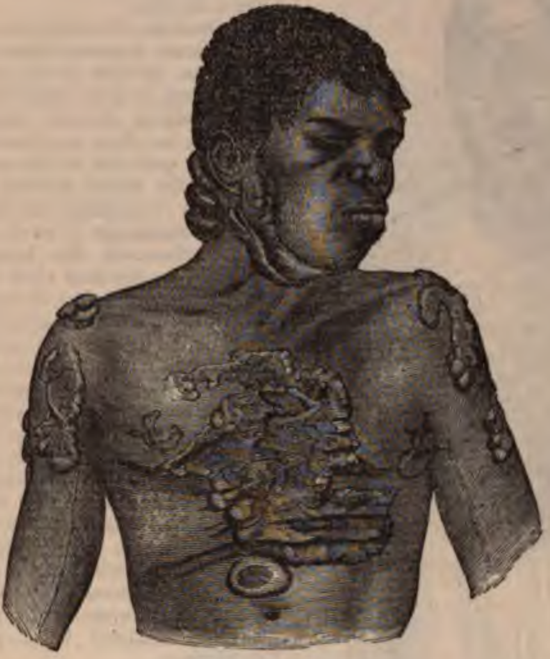
[1] A very remarkable growth of cicatricial fungoid keloid in a negro is figured and described by Dr. Maury, in the Photographic Review, Oct. 1870.

Keloid is a connective-tissue new growth. Under the microscope the lesions are seen to be made up of a dense fibrous mass of tissue, whitish in color and composed of compact bundles of connective tissue having their seat in the corium.

The symptoms of keloid are so striking in character that no difficulty is experienced in the diagnosis. It is most liable to be mistaken for simple cicatrix, from which it may be distinguished by its color, outline, elevation, and consistence, and frequently by the presence of pain.[1]

The treatment of keloid is rarely satisfactory. When operated upon by the knife or caustic, it is apt to return, and frequently in an aggravated form. Caustic potassa is the best caustic to use, but the growth should never be touched while it is still making progress, or certain disappointment will be the result. Hypodermic injections of morphia are occasionally required to allay the pain. Chloroform and anodyne ointments may also be prescribed for the same purpose, and I have used the fluid extract of hamamelis with benefit. Wilson recommends painting the growth with a solution composed of one drachm of iodide of potassium, an ounce of soft-soap, and an equal quantity of alcohol; followed by the application of lead plaster spread on a piece of soft leather, the dressing being kept on a week and then replaced by another. I have used the lead plaster alone in several cases of small keloid growths with gratifying result.

Fig. 936.



Keloid growths.

The prognosis of keloid is not very favorable as to disappearance. The utmost that can be said in any given case is that it *may* disappear either spontaneously or under the use of appropriate remedies after a time. Its course is usually progressive, with occasional temporary arrest of development.

MOLLUSCUM FIBROSUM.

Molluscum fibrosum is a connective-tissue new growth, characterized by sessile or pedunculated, soft or firm, roundish, painless tumors, varying in size from a split pea to an egg or larger, seated beneath and in the skin.

The growths may occur singly or in great numbers, when they usually occupy the greater part of the body. They assume various shapes; rounded and sunken in the skin itself or in the subcutaneous tissue; or in other instances club or pear-shaped and pedunculated, hanging often by thin elongated pedicles. In consistence they are uniformly soft, but

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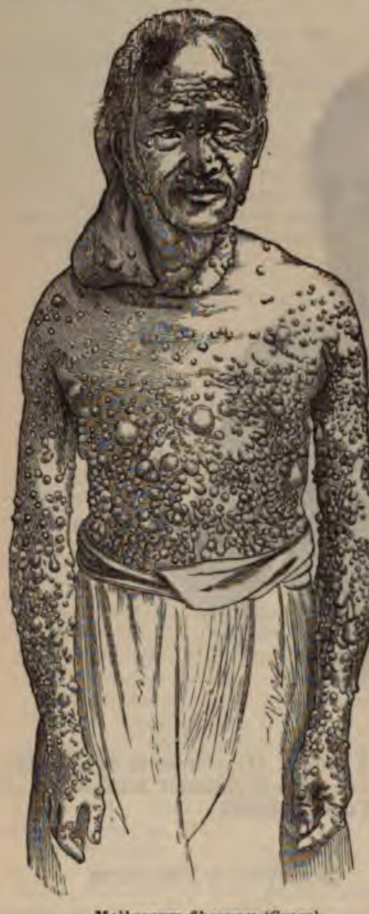
[1] The disease has absolutely nothing in common with the so-called Addison's keloid, which is now known as morphœa (q. v.)

between the fingers are found to have a certain amount of body, the larger ones having a more or less elastic feel. The skin covering them is nearly normal in color or appearance. It may be loose or stretched; hypertrophied or atrophied.

Fig. 937.



Molluscum fibrosum (Gross).

The size of the tumors varies exceedingly; they are usually pea to cherry size, but may be much larger, single pedunculated ones often weighing many pounds. They are more apt to be found on the trunk, and may exist in great numbers, irregularly distributed over the surface. They are not attended with any pain, but may be annoying from their size or weight, or may interfere with the clothing or movements of the body. They may appear at any time during life, generally first showing themselves in childhood, and may grow slowly or rapidly at first, during life. When a certain size is reached they remain stationary, and do not change except that the large pedunculous tumors may ulcerate on the surface from mere weight.[1]

It is a curious fact, noted by Hebra, Duhring,[2] and others, that the patients coming under notice with this affection are stunted in both physical and mental development. The general health of the patient is not impaired by the disease, which, however, may be inherited, and may show itself in several members of the same family.[3]

A section of a fully-developed tumor of molluscum fibrosum shows it to consist of a white fibrous mass, from which, on squeezing, a little yellowish fluid exudes. The tumors cannot, generally, be enucleated, as they are firmly bound down by their pedicles to the subcutaneous tissue. Old dense fibrous growths may, however, sometimes be dissected out.

The diagnosis is easy. From molluscum sebaceum the tumors are distinguished by the fact that they do not possess any depression or aperture on their summits. From neuromata they are distinguished by the absence of pain, and from lipomata by the soft and lobulated structure which those fatty growths possess.

The treatment of molluscum fibrosum is simple. Where the growths are large, or are situated so as to give annoyance, they may be removed by the knife. If pedunculated, they may be ligated or removed by the galvano-cautery.

The disease commonly lasts through life, although some of the tumors may undergo involution. The tumors either continue to increase in size and number, or, having attained their growth, remain stationary.

NEUROMA CUTIS.

Under this name Duhring[4] has described a disease, of which only two cases are upon record,[5] but which possesses features of great interest. It is characterized by the presence of variously sized and shaped neuromatous growths, having their seat primarily in the true skin. The lesions are visible to the eye as split-pea-sized tubercles, scattered or aggregated in large numbers over the affected locality. (In one case this was the shoulder and arm, in the other case the buttock and thigh.) The lesions are of a rose or pink color, smooth, and firm, and the intervening skin normal. The affected side is warmer than the neighboring parts, and during a paroxysm becomes hot and violaceous.

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[1] Interesting cases with portraits have been reported by Wigglesworth, of Boston, Archives of Dermatology, July, 1875, and Octerlony, of Louisville, ib., April, 1876.

[2] Phila. Med. Times, March 18, 1876.

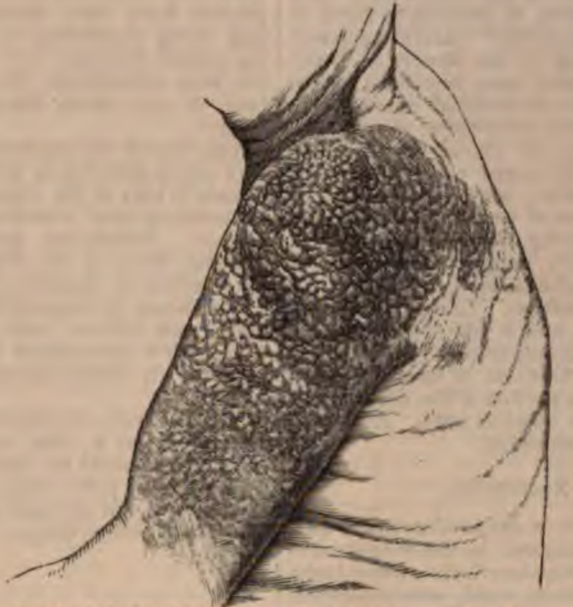
[3] See a paper by Dr. I. E. Atkinson, of Baltimore, New York Med. Journ., Dec., 1875, reporting two cases. Also a report of three cases by Dr. John Murray, Lancet, March 22, 1873.

[4] Am. Journ. Med. Sci., Oct., 1873, July, 1874, and Oct., 1881. The pictures here given illustrate Dr. Duhring's case.

[5] Kosinski, Ctbl. f. Chirurgie, No. 16, 1874, reports the second.

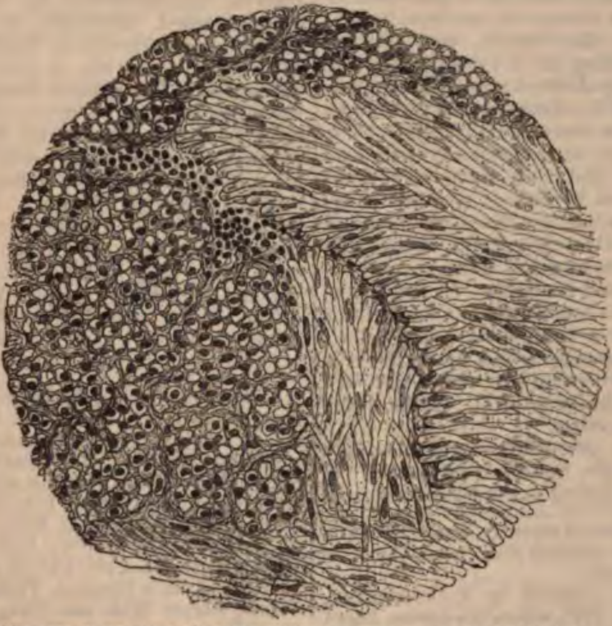
Pain of a paroxysmal character, only showing itself several years after the dis-

Fig. 938.



Painful neuroma of the skin; external appearance (Duhring).

Fig. 939.



Microscopic structure of neuroma, from the same case as fig. 938 (Duhring ease first appears, is the most marked feature. In Duhring's case movement of the affected part, cold air, mental worry or excitement sufficed to bring on excruciating pain, radiating along the various nerves. The general health is not impaired. Exsection of a portion of the sciatic nerve relieved Kosinski's case, but a similar operation, in Duhring's, failed to give permanent relief.[1] Careful microscopic examination of the tumors in Duhring's case showed them to consist almost entirely of non-medullated nerve-tissue, lying in a connective-tissue stroma, together with yellow elastic tissue, blood-vessels with thickened walls, containing numerous nuclei, and surrounded by small collections of round, lymphoid, cell-like bodies (see fig. 939).

This affection must be distinguished from painful subcutaneous tubercle, a not uncommon affection. Here the lesion is usually single, and is not situated in the skin, but in the subcutaneous tissue.

The only treatment of neuroma cutis is excision of a portion of the nerve-trunk leading to the affected area. Anodynes have little or no effect.

XANTHOMA.

Xanthoma is a connective-tissue new growth characterized by the formation of yellowish, circumscribed, irregularly-shaped, variously sized, non-indurated, flat or raised patches or tubercles. Two varieties are met with: *xanthoma planum* and *xanthoma tuberosum*. In the first variety the disease consists of pea-sized or larger, usually elongated, patches, having their seat in the corium, very slightly raised, or looking as if inlaid; they are usually sharply-defined, smooth, and apparently normal in structure; they are more apt to occur on the eyelids; their color is buff to orange, or occasionally pale and cream color, and they have sometimes been compared to bits of chamois skin; they begin as small pea-sized patches, and slowly enlarge through years. Sometimes they are single, at other times several occur together and coalesce. In the tubercular form the lesions, as the name indicates, assume a tubercular appearance; they are not usually found upon the eyelids, but elsewhere on the body; they are sometimes slightly painful. Both forms may occur together.

The disease generally occurs in middle or advanced life, but cases have been reported in the young;[2] the lesions are usually single, or very few in number, but are sometimes numerous. In the majority of cases the disease begins in the eyelids, at the inner canthus. Next it invades the palms and sores, face, ears, flexures of the joints, extremities, and, lastly, the trunk. Occasionally the mucous membranes are affected, and similar patches have been found in the spleen and lining membrane of the bile-ducts; the disease develops very slowly, and usually lasts throughout life. It may, however, in rare cases, disappear spontaneously.[1]

The causes of xanthoma are obscure. The vexed question in the etiology of the disease is that of its dependence or non-dependence upon jaundice or other liver disease. Xanthoma palpebrarum, the macular form of the disease, is seldom associated with jaundice.[2]

Xanthoma is essentially a connective-tissue new growth with fatty degeneration, a view entertained by the majority of those who have investigated the subject.

The only plan of treatment is excision, which may, as a rule, be readily carried out. Care should be taken in operating on the eyelids not to make too deep an incision; it is not necessary to go deep, and there is of course danger of ectropion in scarring.

LUPUS ERYTHEMATOUS.

Lupus erythematous is a cellular new growth, characterized by one or more circumscribed, roundish, or irregularly-shaped, variously-sized, reddish patches, covered with grayish, or yellowish adherent scales. The disease usually begins in the form of one or more roundish pin-head to small pea-sized erythematous patches, which enlarge upon their periphery and often coalesce, to form larger irregularly shaped patches. After a time the patches increase in thickness and show more infiltration, and when fully developed, there may be a number of patches varying in size from a split pea to a silver dollar, or the palm of the hand, having usually a distinct and clear-cut marginal outline. In color they are reddish or violaceous, and are invariably covered with fine or coarse, grayish or yellowish remarkably adherent scales, at times scanty, at other times forming sebaceous-looking crusts, like those found in seborrhœa of the face. They are firmly attached to the openings of the sebaceous glands, which are often denuded and plugged up with sebum, or patulous. The patch spreads on its margin, which is usually higher than the centre, which is commonly paler, and often shows atrophic depression. After a variable time the patch attains a certain size, and may remain stationary. There is never any moisture or discharge in connection with the disease.

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[1] This was proved recently, on the patient's death, to have resulted from regeneration of the excised nerve.

[2] See a case reported by T. Colcott Fox, Lancet, Nov. 8, 1879, where the disease began in the second year.

[1] See cases reported by Fagge, Trans. Path. Soc., London, vol. xix.; W. F. Smith, ib., vol. xxviii.; and Legg, Lancet, Oct. 25, 1879.

[2] Those desirous of examining into the controversy on this question may refer to various communications by Fox, Lancet, Nov. 8, 1879; Carry, Annales de Derm. et de Syph., N. S., tome i., No. 1, 1880; Pye-Smith, Trans. London Path. Soc., vol. xxviii.; Tilbury Fox, Epitome of Skin-Diseases, Phila., 1879; and White, Boston Med. and Surg. Journ., Oct. 23, 1879.

Lupus erythematosus is usually found upon the face, one or both cheeks below the eyes and the bridge of the nose being the commonest seat of the affection. Often both of these localities are attacked by the disease, which forms the rude figure of a butterfly with outstretched wings.[1] The muco-cutaneous and mucous surface of the lips, the ears, scalp, back and other parts of the body may be attacked. Lupus erythematosus is remarkable for its chronicity, and may persist through life. It tends to increase from time to time by repeated attacks. Ultimately, the process generally ends in the formation of a superficial or deep-seated cicatricial tissue.

The subjective symptoms vary in different cases, depending somewhat upon the activity of the disease. At times there is much burning and itching, while in other cases, there may be no subjective symptoms.

The causes are obscure, although in my experience it is common to find it in persons of a scrofulous tendency. Females are more liable to it than males, and light- than dark-haired persons, and it occurs notably on those who are subject to disorders of the sebaceous glands, sometimes indeed appearing to originate in a patch of localized seborrhœa.

In the light of recent observation the disease may be regarded as an inflammation of the cutis, accompanied by cell-collections about the follicles and glands, leading to degeneration and atrophy. As a rule it has its seat primarily about the sebaceous glands and follicles. Kaposi[2] and Thin[3] have shown that the sweat-glands may also be the seat of the disease, while according to Geber[4] and Stroganow,[5] all the structures and every layer of the skin, even to the subcutaneous connective-tissue, may be at one time or another the seat of origin, and the chief centre, of the morbid process. If retrograde metamorphosis takes place in the earlier stage of the pathological process, the cell infiltration is absorbed and the patches disappear without leaving any trace behind. Usually, however, atrophy results, which becomes cicatricial when the glands and hair-follicles are involved.

When fully developed, the typical patch of lupus erythematosus offers such a striking picture with its reddish or violaceous color, its sharply circumscribed outline, its infiltrated surface studded with plugged-up or gaping sebaceous openings and covered with adherent sebaceous scales, and its place of election, the nose and cheeks, that it can scarcely be mistaken for any other disease. It is to be distinguished from lupus vulgaris by the absence of papules, tubercles, and ulceration. The sebaceous glands are not affected in lupus vulgaris. Lupus erythematosus rarely begins before puberty; lupus vulgaris usually appears in childhood. Lupus vulgaris is a deep-seated disease, and attended sooner or later with ulceration and disfiguring cicatrices; lupus erythematosus is comparatively superficial. Psoriasis sometimes resembles lupus erythematosus very closely, but may be distinguished by its course, and by the various symptoms peculiar to it. Syphilis sometimes resembles lupus erythematosus superficially. but its history is very different.

The results of treatment in lupus erythematosus are extremely varied. At one time the therapeutic measures employed will prove rapidly and easily successful, while in another apparently equally light case every known method of treatment may be exhausted without producing more than a temporary effect on the course of the disease. Internal remedies are called for in some cases. They are to be selected to meet the especial indications which may be manifested. Iodine and arsenic, iodide of potassium, and cod-liver oil may one or another often be employed with advantage. Dr. McCall Anderson recommends iodized starch very warmly. It is made in the proportion of twenty-four grains of iodine to one ounce of starch, the iodine being triturated with water, and the starch gradually added. The dose is a teaspoonful or more. In four cases where this remedy has been faithfully used, it has, in my hands, entirely failed, but I give it because endorsed by so high authority, and because the internal therapeutics of lupus erythematosus are so meagre. Hygienic measures, chiefly nourishing diet, fresh air, and sea-bathing are important.

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[1] See Duhring's Atlas. Plate C.

[2] Pathologie und Therapie der Hautkrankheiten, Wien, 1880.

[3] Med.-Chir. Trans., vol. lviii., 1875.

[4] Vierteljahresschr. für Derm. u. Syph., iii., Jahrg. 1876, Heft 1.

[5] Centralbl. für Med., 1877, No. 48.

The external treatment is that which will usually be found most available and of the greatest value. In the milder forms of the disease it is to be remembered that patches often disappear without leaving a scar. Care must be taken therefore not to make matters worse than they would naturally turn out. No strong caustics are to be used in such cases. Stimulating applications may be first tried. Sapo viridis is one of the best of these, relieving the disease by itself alone when used in mild cases. It may be applied spread upon cloth in the form of a plaster, or rubbed in with water. In the form of the spiritus saponis kalinus (two parts of sapo viridis dissolved in one part of alcohol), it is of even greater value. The patches are to be well scrubbed with the spirit until all scales are removed, when it may be washed off with water and some mild ointment applied. Mercurial ointment is useful in some cases, prepared as a plaster and applied continuously. Sulphur may sometimes prove serviceable in the form of an ointment, a drachm or more to the ounce. Chrysarobin and pyrogallic acid have been used with success in the form of ointment, a scruple to a drachm to the ounce. Stronger and even caustic applications are sometimes demanded, but they should never be used until the weaker ones have been tried. A solution of caustic potassa, one part to three or six of water, is one of the best of these; it may be applied by means of a charpie-brush on a stick. I have used fuming nitric acid with success; it is less painful than the potash. The curette or scraping spoon is often of use.[1] The galvano-cautery has also been used with success.[2]

The prognosis of lupus erythematosus should be guarded; the disease often proves stubborn, resisting treatment for years. Relapses are apt to occur.

LUPUS VULGARIS.

Lupus vulgaris is a cellular new growth, characterized by variously-sized and shaped reddish or brownish patches, consisting of papules, tubercles, or flat infiltrations, usually terminating in ulceration and cicatrices.

The disease varies in appearance in different cases, and also according to the locality attacked and the stage of its development. It usually begins by the formation of small yellowish-red or brown points under the skin, which increase in size, coalesce, and form irregularly-shaped, roundish or serpiginous, ill-defined patches of various size. The points referred to enlarge until they form papules, and finally tubercles. It is at this stage that the disease usually comes under notice. The lesions are of all sizes, from a pin's head to a split pea, are brownish or yellowish-red in color, and are covered with a thin layer of imperfectly formed epidermis. They are firm or soft, and are painless. At this stage of development the disease may retrograde and terminate in absorption of the lesions, leaving a thin desquamative cicatricial tissue, or it may go on to ulceration and complete destruction of the infiltrated skin, resulting in much disfigurement. Various names have been given to the different forms of lupus vulgaris, as *L. exfoliativus*, *L. exulcerens*, *L. exedens*, *L. hypertrophicus*, *L. verrucosus*; these, however, are rather stages of the affection than varieties. The disease may be arrested at any point in its evolution, and thus constitute a variety. Sometimes several or even all the varieties may be present at once in the same subject. In its earlier stages lupus vulgaris is rarely attended by any subjective symptoms, but later there is sometimes pain. The commonest seat of the disease is about the face,[1] especially the nose, cheeks, and ears. It frequently attacks the extremities, especially the fingers, where it may result in serious deformity. The trunk may also be involved. Lupus vulgaris is a destructive disease, often resulting in serious disfigurement. It spares none of the external tissues, and may invade the mouth, cartilages of the nose, ear, larynx, and even the eye.

The disease usually originates in childhood. It is never congenital. It is rarely if ever hereditary. It is much commoner in Germany, Austria, and France than in England, Scotland, and Ireland, and it is very rare in natives of the United States. I do not remember to have met with a case where the patient was born in this country, though I cannot say that it never attacks the native American. It is a disease of the lower classes, not commonly attacking the well nourished, but usually the debilitated and ill-fed.

The pathological anatomy of lupus vulgaris has been studied with great diligence by a number of observers. Kaposi, in his recent work,[2] gives the clearest and most exhaustive description of the appearances with which I am acquainted. Under a low power, he says, microscopic sections of deeply-seated, recent lupus nodules show variously-sized, roundish, nest-like masses of tissue irregularly dispersed through the lower part of the corium, the upper and papillary layers of which, however, as well as the site, appear normal. Under a higher power, these foci are seen to be composed of a finely branching network, sharply defined from the neighboring healthy connective tissue, plentifully supplied with large vessels, and in the larger meshes of which are embedded cells containing numerous highly refracting nuclei, which stain well. The smaller meshes contain, in addition, much smaller cells with sharply contoured nuclei in large numbers. The embedded elements can sometimes be readily shaken out of the meshwork, leaving empty spaces behind in place of the foci of formed elements. These appearances are only found in recent nodules. The recent lesion presents a rapidly proliferating tissue, rich in vessels. When retrogressive metamorphosis sets in, decreased vascularity of the centre of the nodule occurs, and the formed elements are either absorbed, or, in superficial situations, are thrown off, the invaded cutaneous tissues undergoing cicatricial contraction. It is characteristic of lupus vulgaris in distinction from lepra and syphilis, that part of the lupus tissue undergoes organization into fine, and later into coarse, connective-tissue. Giant cells are found in the lupous infiltration.

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[1] See Wigglesworth; the Dermal Curette. Boston Med. and Surg. Journ., Feb. 10, 1876.

[2] Further details and forms of treatment may be found in Duhring's Treatise, 2d ed., p. 440 et seq.

[1] Duhring's Atlas, Plate BB.

[2] Pathologie und Therapie der Hautkrankheiten, Wien, 1880.

While some lesions are undergoing the changes above described, others extend, unite, and give rise to a diffuse cell-infiltration, involving all the tissues of the skin, and finally ending, as a rule, in cicatricial contraction. When the lupus process has gone on for some years, a condition of the tissues resembling elephantiasis may result. In some cases the papillæ become highly developed and verrucous in character, constituting lupus hypertrophicus or verrucosus.

The epithelial structures are involved at an early stage. The skin, glands, and hair-follicles are involved, and the hair lost. Sometimes milium-like nests or pearls of epithelium form about the glands, which may become a basis for the development of epithelioma.[1]

The diagnosis of lupus vulgaris from syphilis, the disease with which it is most likely to be confounded, is chiefly to be made by the history of the case in question. In addition, the ulcers of lupus are comparatively superficial; those of syphilis ordinarily deep, and often have an excavated appearance. The ulcer of lupus is commonly less extensive than that of syphilis. In lupus there are, as a rule, a number of points of ulceration which incline to become confluent; whereas the ulcers of syphilis usually remain distinct. The border of the syphilitic ulcer is sharply defined; that of lupus is not apt to be so. The secretion of the syphilitic ulcer is apt to be copious and offensive; that of lupus is scanty and inodorous. The crusts of lupus are thin and brownish; those of syphilis are bulky, and frequently have a greenish tinge. Lupus is slow in its course; syphilis is rapid. A syphilitic ulcer may form in five or six weeks, while it would take as many years for the lupus disease to give rise to so much destruction. The scar of lupus is contracted and distorted; hard, shrunken, and yellowish. That of syphilis is whitish, smooth, thin, often surprisingly slight considering the destructive process which has gone before. A history of other syphilitic lesions is sometimes, though by no means always, to be obtained in syphilitic ulcer, and too much stress must not be laid on the absence of this.

Lupus may be confounded with epithelioma. Though the diseases may occur together, yet such occurrence is rare. The localization of epithelioma, with its usually painful character, and the circumscribed induration of the lesion, will usually serve for the diagnosis. The ulceration of epithelioma generally starts from one point and spreads peripherally, while the ulceration of lupus usually begins at many points within the patch. Epithelioma very seldom occurs in the young; lupus begins in childhood.

Lupus vulgaris is to be distinguished from lupus erythematosus by the occurrence of ulceration, which never takes place in the erythematous form of the disease. The patches in lupus erythematosus are superficial, uniformly reddish in color, and are covered with adherent, grayish scales. They are, moreover, circumscribed, and are without papules or tubercles. The sebaceous glands and follicles are generally markedly involved in lupus erythematosus; in lupus vulgaris they remain unaffected.

Acne rosacea at times bears some resemblance to lupus vulgaris, but may readily be distinguished by its dilated vessels, color, the presence of acne pustules, its history, and its course.

Lupus vulgaris appears to be somewhat more amenable to internal treatment in this country than abroad. It is, however, one of the most obstinate of all cutaneous diseases. Hygienic treatment is of great importance. Cod-liver oil is the most efficient internal remedy, and next to this iodide of potassium. It may be given with the oil, as also may iodine and phosphorus. Internal remedies should usually be well tried before external applications are made, as they alone sometimes suffice to obtain a cure. The external remedies ordinarily used in lupus vulgaris are of a mechanical nature, or comprise the various caustics. They should be selected with a view to the extent, locality, and character of the lesions in any given case. In the earlier stages stimulating applications may be employed, with a view to bring about absorption; equal parts of tincture of iodine and glycerine, painted over the part, mercurial plaster, tar, and ointment of the red iodide of mercury may be used for this purpose. I must confess, however, that in my hands these milder remedies have usually failed of success. Of true caustics, potassa, nitrate of silver, arsenic, carbolic acid, acetate of zinc, chloride of zinc, and pyrogallic acid may be mentioned. The first and last of these I believe to be most efficient.

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[1] Duhring, loc. cit., p. 444 et seq., gives a fuller résumé of the pathological histology of lupus vulgaris, with references to recent original investigations.

Lang, Vierteljahressch. f. Derm. u. Syph., 1874, p. 165, and Kaposi, ib., 1879, p. 73, have described the combination of lupus and epithelioma.

Caustic potash in stick should be used when thorough and extensive destruction of tissue is desired. It should be remembered that the effect of this caustic goes somewhat beyond the point touched. Acetic acid of the officinal strength should always be kept at hand to limit and check the spread of the caustic and to neutralize it. The pain is severe for the moment, but ceases on the application of the acetic acid. Nitrate of silver is efficient, and does not leave scars. It does not penetrate deeply. Papules and tubercles may be destroyed by boring into them with the solid stick, while patches are most successfully treated by the solution, repeatedly applied with the charpie brush. Dr. Duhring thinks it the safest and best caustic to use about the face, where scarring is if possible to be avoided.

Pyrogallic acid is used in the form of an ointment in the strength of one or two drachms to the ounce, spread thickly upon cloths, and renewed daily. It is comparatively painless, and is therefore more useful than the arsenical pastes, which I have never used and cannot recommend.

Chloride of zinc may be used as a paste in the following formula, proposed by Hebra: Equal parts of chloride of zinc and chloride of antimony, with sufficient strong hydrochloric acid to dissolve the chloride of zinc. They are to be rubbed up in a mortar with enough powdered liquorice-root to make a paste, and spread upon a piece of cloth and applied while moist. It is a very strong caustic, and should be applied only when it is desirable to destroy the whole patch, for it acts upon healthy as well as upon diseased skin.

The method of erasion or scraping, as introduced by Volkmann, of Halle,[1] is very useful in many cases, and may be regarded as a most valuable means of treatment. It is performed by means of the dermal curette, or scraping spoon, made of various sizes and shapes.[2] The part to be operated upon is first frozen by means of a hand-ball atomizer, charged with rhigolene, or by the application of a gauze bag filled with powdered ice and salt, and then the diseased tissue is scraped or dug out. If any of the diseased tissue is left, a recurrence of the lupus must be looked for; the operation, therefore, must be thorough. Scraping may often be appropriately supplemented by the application of caustics, as pyrogallic acid, potassa, or the galvanic battery.

Both the actual cautery and the galvano-cautery are used in the treatment of lupus. Neumann[3] and Piffard[4] describe the method, and figure convenient instruments. The treatment by multiple puncture, or scarification, has been very successful in Mr. Balmanno Squire's hands.[5] He has devised a many-bladed knife by means of which the skin, previously frozen, may be scarified, and a traumatic inflammation set up, under which the disease heals. Schiff[6] suggests the injection of caustic liquids by means of a rubber pipette, to which is attached a hypodermic syringe needle; this being charged with the caustic solution, the point of the needle can be introduced into the lupus nodule, and a single drop of the caustic injected exactly at the desired point.

The prognosis of lupus vulgaris will depend upon the form of the disease, its duration, the age of the patient, and the extent of surface involved. The disease, in any case, is very stubborn and runs a chronic course. If it be confined to one patch or region, a more favorable termination can be looked for. The disease usually results in marked scarring and deformity.

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[1] Sammlung Klinische Vorträge, No. 13, Leipsic, 1870.

[2] See an article by Mr. Balmanno Squire, giving cuts of two kinds of spoons, both of which I have used with great satisfaction.

[3] Lehrbuch der Hautkränkheiten, 5ten Aufl., Wien, 1880, p. 463.

[4] Therapeutics of Diseases of the Skin, New York, 1880.

[5] Transactions of the British Medical Association, Archives of Dermatology, 1879, p. 413. See also, ibid., Oct., 1879, p. 425.

[6] Vierteljahresschr. f. Derm. u. Syph., vii., Jahrg. 1880, p. 247.

SCROFULODERMA.

Under the name scrofuloderma, are included those morbid conditions of the skin which are the peculiar expression of the condition of the system designated as scrofula, scrofulosis, or struma. While there are a number of diseases which appear to be more or less influenced by the strumous condition, or even occasionally due to this alone, yet those about to be described are so closely and exclusively connected with scrofula as to deserve separate consideration.

In the commonest form the affection begins in one or more of the lymphatic glands, which become swollen and permanently enlarged. Having reached the size of an almond or so, they either remain hard and unchanged for an indefinite time, or they soften. The skin covering them becomes hyperæmic, chronically inflamed, of a violaceous hue, and by degrees thin and sensitive. After a time, usually months, fluctuation is noticeable, the tumor breaks open, discharging pus and serum mingled with blood, and a whitish or yellowish flaky caseous matter. The fluid is sometimes purulent and sometimes serous, and the process, an exceedingly chronic one, goes on for months and years, with the formation of sinuses which burrow deeply and invade adjacent tissues, followed by gradual breaking down of the glands, and the final formation of elongated, almond-shaped, variously-sized ulcers, with irregular, thin, more or less undermined edges, and pale-red, or violaceous in color. The bases of these ulcers are uneven, and usually studded with unhealthy-looking, pale, flabby granulations. They incline to bleed easily. There is usually little crusting, but when a crust forms it is brownish or grayish in color, thin and adherent; when removed, the ulcer is apt to bleed. The scrofulous ulcer is indisposed to heal. It looks as if it were on the very point of cicatrization, but it does not actually scar over. The reparative process is slow. As a rule, it is not painful. The scar is of a hard knotty character.

The disease is usually met with about the face, beneath the lower jaw, and around the neck. I have sometimes seen it above or below the clavicle on either side. It is usually accompanied by other symptoms of the scrofulous condition. Old scars, the result of previous lesions, may often be detected in one region or another.[1]

Scrofuloderma is to be distinguished from lupus vulgaris, and from syphilis, by the presence of the concomitant general symptoms of scrofulosis, and by the peculiar features of the lesions, which differ materially from those of lupus and syphilis. The characters of the primary lesions, the ulcers and the crusts, differ materially. When the diagnosis between scrofuloderma and syphilis is difficult, the history will aid.

The treatment of scrofuloderma must be directed first against the general condition. Cod-liver oil, iodine, and the preparations of sulphur, phosphorus, and iron are most usually serviceable. Sea-air and hygiene are of importance. The diet should be generous, and should consist largely of animal food. Locally, the ulcers are to be treated with stimulating ointments, those containing mercury in particular. Lotions of corrosive sublimate and alcohol, a quarter-grain to the ounce diluted, if necessary, tincture of iodine diluted, and solution of chlorinated soda may also be employed with advantage. Chlorate of potassium, as recommended by Drs. Harkin and Shoemaker, in powder or solution, has been used with advantage, and is, I think, a good remedy. I have used the dermal curette in several cases to advantage, following it up with one of the above-mentioned applications.

TUBERCULOSIS OF THE SKIN.

The existence of tuberculous ulceration of the skin has been disputed recently; however, authentic cases have been described by Chiari[1] and Jarisch.[2] The ulcers are roundish, ovalish, or (as in Jarisch's case) serpiginous, with irregular, gnawed, bright red, swollen, moderately infiltrated edges, the ulcerating surface being granular and of a reddish yellow color. The secretion is thin and scanty. They do not bleed easily when handled. When they occur on the mucous membranes, they show small, pin-head-sized, yellowish papular lesions in the neighborhood. The disease is invariably found in tuberculous subjects, and runs a rapid course.

LEPRA.

Lepra is an endemic, chronic, malignant constitutional disease, characterized by alterations in the cutaneous, nerve, and bone structures, resulting in anæsthesia, ulceration, necrosis, general atrophy, and deformity. Leprosy is a constitutional disease, and involves the whole organism most profoundly. Its invasion is slow and insidious. Premonitory symptoms of malaise, mental depression, languor, sleepiness, loss of appetite, nausea, chills, repeated attacks of fever, general debility, nervous prostration, and pains in the bones are usually present and may last for weeks, months, or years without other symptoms. Sooner or later, however, the more characteristic features of the disease, the bullous, macular, pigmentary, or tubercular skin-lesions make their appearance. These may appear separately, successively, or together. Sometimes the skin-lesions are prominent symptoms of the disease; at other times they are subordinate. Other organs of the body, as the nerves, are also affected.

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[1] For a description of the rarer forms of scrofuloderma, see Duhring, l. c., p. 453.

[1] Wien. Med. Jahrb., 1877, Hft. 3, p. 328, and Vierteljahresschr. für Derm. u. Syph., vi., Jahrg. 1879, p. 269.

[2] Ibid., p. 265.

Two forms of leprosy are recognized, the tubercular and anæsthetic. No absolute line, however, separates them, and they often appear simultaneously upon different parts of the body, and one may pass into the other. The tubercular variety is characterized by the formation of masses of infiltration and tubercles. Other lesions are also found. An eruption of pemphigus-like blebs, showing themselves irregularly for some time before the appearance of other lesions, is one of the earliest symptoms, though it is said these more frequently precede the macular variety of leprosy than the tubercular. Macules now make their appearance as smooth, shining erythematous patches, usually defined, infiltrated, not commonly raised above the level of the skin, yellowish or reddish in color, and growing dusky, yellow, and brownish as they grow older. Sometimes they are paler, and look like a piece of cut raw bacon set into the skin. They are commonly surrounded by a pinkish or lilac border of small bloodvessels. The sensibility of the skin is altered from the beginning, the patches being at first hyperæsthetic, and later anæsthetic. They may appear anywhere on the body, but most commonly upon the trunk and extensor surfaces of the extremities. Sometimes they are present in such numbers as to involve a considerable area of the body; they may disappear and reappear from time to time, or they may remain as permanent lesions, in which case they increase in size.

Sooner or later the disease shows itself in the form of variously-shaped and sized nodules and tubercles, situated in the skin and subcutaneous tissues, which may develop into roundish, irregularly shaped prominences and elevated masses, from cherry to walnut size, or larger; conspicuous and prominent or slightly raised, and having a yellowish, brownish, or bronzed color. They are more or less painful when pressed upon. They are usually found upon the face, and chiefly the forehead, eyebrows, cheeks, nose, lips, chin, and ears are apt to be invaded, giving rise to deformity, often of a hideous character. Later the mucous membrane of the mouth, pharynx, epiglottis, larynx, and nares are attacked; the eye also suffers. Besides the face, other portions of the body, notably the trunk, buttocks, arms and legs, fingers and toes, are invaded. The course of the tubercle varies; it may last a long time without change, or it may soften and ulcerate at once; or it may be absorbed. Ulceration is apt to occur about the fingers and toes, the ulcers being covered with adherent brownish crusts.

The anæsthetic variety of leprosy may occur in conjunction with the tubercular variety, or alone, in which case it is characterized by the presence of a number of symptoms in addition to the anæsthesia. Blebs are apt to appear first, coming out in an irregular manner from time to time, and being followed by pigmentation, and after a longer or shorter time by anæsthesia about the seats of the former lesions. In other cases macules, like those which sometimes precede the tubercular form, come first. Hyperæsthesia of the skin sometimes occurs with pains and burning sensations, followed by anæsthesia affecting a limited portion or the greater part of the surface. Later the skin becomes atrophic, dry, yellowish, or brownish in color, and more or less wrinkled.

Following this alteration in the structure of the skin, the subcutaneous tissues and muscles undergo atrophy, giving rise to deformity, especially of the fingers and toes; the hair and nails become altered in structure, or are shed; the hands and feet become greatly mutilated; the fingers and toes bent, crooked, and contracted. Sooner or later the bones are attacked, causing destruction of the joints and of the bones themselves; the skin over the joints becomes excoriated and ulcerated; the ends of the bones undergo disintegration, and the phalanges finally either become absorbed or drop off. Even the hands and feet may gradually be lost; the extremities become more or less completely anæsthetic, and are greatly wasted, at times to half their former size.

The causes of leprosy still remain obscure. It is endemic in Africa, along the shores of the Mediterranean, and of the Atlantic and Indian Oceans, as well as in the interior of the country; also in Asia Minor, Arabia, Persia, India, China, Japan, Kamtschatka, the various islands of the Pacific Ocean, and Australia. In Europe it is found in Norway, Southern Spain, Sicily, Greece, and Southern Russia. Upon the Western Hemisphere it occurs in Mexico, Central America, the islands of the West Indies, along the coast of South America, and especially in Brazil; it also exists in Iceland. The disease is likewise found in the United States.[1]

Leprosy is in many instances hereditary, and may be conveyed from parent to child through a series of generations. Concerning its contagiousness, opinions differ, and the matter cannot as yet be said to be definitely settled. The most potent causes in the production of the disease appear to be connected with climate, state of the soil, food, and habits of the people. The disease usually occurs among the lowest classes, but it may attack those in the most favored circumstances. It occurs in both sexes and at any period of life.

The pathology of leprosy has been carefully studied by various observers.[2] The microscopic appearances of the lesions show a deposit of new material, made up of cells similar to those encountered in lupus and in syphilis. In the later stage of the process, the epidermis, hair, sebaceous and sweat-glands all atrophy, and in time become more or less obliterated, ultimately the tubercles incline to soften, disintegrate, and break open into chronic, superficial or deep ulcers; their course, Duhring says, may be compared to that of the gummatous syphiloderm, though more sluggish. The nerves of the body also undergo marked and peculiar changes essentially of a chronic inflammatory nature. These changes about the nerves account for the clinical symptoms of hyperæsthesia and anæsthesia, which are so conspicuous in the disease.

The diagnosis of leprosy, in countries where this disease is endemic, is usually easily made. The earliest premonitory symptoms arouse suspicion, which the appearance of the cutaneous manifestations confirms beyond doubt. When the disease occurs sporadically in countries where it is not endemic, it may, however, be mistaken for other affections.

The macular and tubercular varieties are apt to be mistaken for syphilis.[3] The lesions of leprosy, however, are larger and more irregular in size and distribution. The pigmentation of leprosy is of a peculiar yellowish or brownish tint. The lesions have a smooth, glazed appearance. The tubercles are apt to be much larger than those of syphilis, being often hazelnut or walnut-sized, and are darker in color; their course is usually slower than that of syphilitic tubercles. The general expression of the face (the usual seat of the tubercles in leprosy) is much changed, the features having an ugly leonine appearance.

Later, when the tubercles break down into ulcers, the blackish adherent crusts which cover them are seen to be less bulky than those seen in syphilis. With ulceration come other very marked features of the disease, as anæsthesia, distortion of the hands and feet, absorption of bone-tissue, atrophy, and all unmistakably characteristic.

The yellowish, roundish patches of macular leprosy should not be mistaken for vitiligo. The health in vitiligo is generally good, and the patch of disease consists of simple absence of pigment, with usually a border of an increased amount of coloring-matter. The skin is normal in texture. In leprosy, on the other hand, the macules are infiltrated with a lardaceous-looking substance of firm consistence, and are generally anæsthetic or hyperæsthetic.

Morphœa, which is an affection of an entirely different nature, presents lardaceous-looking patches somewhat resembling those of macular leprosy. But the general health in morphœa is good, and the patches show normal sensibility, and tend to spontaneous recovery.

The treatment of leprosy has thus far proved very unsatisfactory. As in the case of most diseases refractory to treatment, the remedies and pretended cures have been exceedingly numerous, but as they have failed for the most part, they need not be mentioned here. The remedies now employed are valuable in improving the general condition of the leper. Change of climate and residence usually to a temperate and bracing atmosphere is imperative. Strict hygienic rules should be adopted, including exercise and bathing, with the most nourishing food. Quinine is important as a tonic, and the usual alteratives may also be employed. Symptoms are to be treated as they arise.

Local treatment is valuable. Baths, plain or medicated with iron or sulphur, are of service. Of recent remedies, the oil of cashew nut, gurjun oil, and chaulmoogra oil, internally and in the form of inunctions, are recommended on good authority.[1]

The prognosis of leprosy is unfavorable. A few cases of cure have been reported, where the patient has been placed upon energetic treatment from the earliest appearance of the disease.

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[1] See the Reports of the Committee on Statistics of the American Dermatological Association, in the Transactions for 1878, '79, '80 and '81.

[2] See Duhring's Treatise, p. 464, for references and fuller discussion of both the etiology and pathology of leprosy.

[3] See a case reported by Dr. Duhring in the Photographic Review, vol. i., p. 72.

[1] For a list of medicines employed, see the Leprosy Report of the College of Physicians, London, 1867.

FRAMPŒSIA.

Frambœsia,[1] called also *yaws*, *pian* and *endemic verrugas*,[2] is an endemic disease, characterized by general and cutaneous symptoms, occurring in the West Indies and other tropical countries. The eruption consists of variously-sized papules, tubercles, and tumors, of a reddish or yellowish color. The lesion appears as a yellowish or whitish point or spot, which gradually enlarges and projects from the surface, looking, when fully developed, like a piece of cotton wick a quarter of an inch or less in diameter, dipped into a dirty yellow fluid and stuck on the skin in a dirty, scabby, brownish setting, and projecting to a greater or less extent (Imray), or at times the lesions look like red currants with flat tops of a bright pink color, glassy, semi-transparent. Larger lesions look like cherries (Hutchinson). The tubercles may be smooth, scaly, or ulcerated. The eruption generally manifests itself on the face, upper or lower extremities, and genitalia. The largest growths occur on the lips, eyelids, toes, and genital organs. The lesions are not painful or itchy. The disease is probably not hereditary. Most observers consider it contagious.[3] It has no relation with syphilis. The treatment, which is effective, consists of hygiene, good food, and tonics, with cleanliness and the use of carbolic-acid solution or a weak nitrate of mercury ointment locally.

CARCINOMA CUTIS.

The commonest form of primary cancer of the skin is epithelial cancer, and it is this form with which the dermatologist usually has to deal.[4]

EPITHELIOMA.

Epithelial cancer of the skin may be either *superficial*, *deep-seated*, or *papillary*. The *superficial* or "flat" epithelial cancer usually makes its appearance as one or more grouped small yellowish or reddish papules or elevations, having their seat in the upper layers of the skin. The disease may originate in a sebaceous gland, wart, or other growth, or in the form of a flat infiltration. After a time, it may be months or even years, the tubercle, wart, or infiltration, as the case may be, becomes fissured or excoriated, a slight brownish crust forms upon it, under which is a scanty watery or viscid secretion. The course of the disease is slow, but gradually new lesions appear, usually connected with the original one, and finally the tubercles break down, and ulceration of a superficial character sets in. The ulcer, at first small, may spread until it attains the size of a coin or even of the palm of the hand. The ulcer is characteristic. It is usually roundish, but may be quite irregular, with either sloping or sharply-defined edges. The border may be smooth and on a level with the skin, but is usually elevated into a pearly ridge all around the ulcer. Its base is usually hard, and secretes a scanty viscid fluid; it bleeds readily. There is usually a peculiar and characteristic picking or crawling sensation in the lesion when it first begins to become fissured or excoriated, but there is usually no pain unless the ulceration is considerable. When fully developed, the ulcer may remain *in statu quo* for an indefinite period, the patient's health meantime being excellent; or it may pass into the infiltrating deep-seated variety to be described. The lymphatic glands are not involved.

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[1] See Papers by Milroy and Imray (Report on Leprosy and Yaws in the West Indies, by Gavin Milroy, London, 1873). Also Tilbury Fox (Diseases of the Skin), and Jonathan Hutchinson (Catalogue of the New Sydenham Society's Atlas of Skin Diseases, part ii., p. 145. See also Plate XLI of the Atlas).

[2] See a paper by Dr. George A. Ward, on Verrugas. Transactions of the International Medical Congress, Philadelphia, 1876.

[3] On the question of the contagiousness of frambœsia, see papers by Drs. Nicholls, Bowerbank, and Milroy, Medical Times and Gaz., 1880, vol. i.

[4] The other varieties of primary or secondary cancer of the skin are the following: 1. *Carcinoma lenticulare* ("scirrhous," "hard," "fibrous" or "connective-tissue" cancer), characterized by smooth, glistening, dull pinkish or brownish-red, flat or raised papules, tubercles or nodules, from pea to bean or larger size, disseminate, at first separate, later running together, slow in its course, involving the neighboring glands, causing pain, breaking down, recurring on excision, and ending fatally. 2. *Carcinoma tuberosum*, a rare affection, occurring in flat or raised, rounded or ovalish tubercular or nodular lesions, from pea to walnut size or larger; firm, hard, deeply imbedded in the skin and the subcutaneous connective-tissue, of a dull-reddish, brownish-red, or violaceous color, multiple, disseminated, or irregularly grouped, sooner or later breaking down into ulcers and ending fatally. 3. *Carcinoma melanodes or pigmentodes*, beginning in the form of multiple, small, pin-head, pea, or bean sized, rounded or ovalish, soft or firm papules, tubercles or nodules, of an iron-gray, brownish, bluish-black, or blackish color, at first discrete, but tending to aggregate into tumor-masses and then to break down and ulcerate, forming often fungous, gangrenous, and pultaceous masses, commonly found starting in a mole or wart on the face or on the hands and feet, usually encountered in early adult or middle life, and pursuing a malignant course.

Rodent ulcer is a form of this variety of epithelial cancer. Its most frequent seat is upon the eyelids, and next to this upon the sides of the nose. When fully developed, it consists of a circumscribed, sharply defined, greater or less excavation, with a brownish-red or purplish-red, dry or scantily secreting, mammillated surface, the ulcer having often a rolled border. Its course is very slow but relentless; it invades every tissue with which it comes in contact, including muscles and bones. If neglected, great destruction of the parts may ensue, and even death from hemorrhage in very advanced cases. A peculiarity of this form of epithelioma is that it is a disease of the upper part of the face, occurring usually above a line drawn across the face horizontally on a level with the alæ nasi and the lower border of the ears.[1]

Deep-seated variety.—This variety of epithelioma, known also as the "infiltrating variety," is much more serious than the superficial variety of the disease. It begins as a split-pea-sized tubercle, situated in the skin and subcutaneous connective-tissue. It sometimes, however, begins in a wart, like the superficial variety. It is reddish or purplish in color, surrounded by an areola, firm and hard to the touch, and accompanied by infiltration of the surrounding tissues. In a longer or shorter time, according to the malignancy of the case, usually months, ulceration begins either from within or upon the surface, the tumor breaks down, and an ulcer of various size results. This is deeply excavated, irregular in shape, with a violaceous base, secretes a viscid offensive fluid, bleeds readily upon being touched, and is surrounded with infiltration, the skin being reddish in the neighborhood. The lymphatic glands become enlarged at a later period, the lancinating pains which are often experienced from the beginning become more severe, the patient suffers extremely and finally succumbs through marasmus and exhaustion. The course of this form of disease, though sometimes slow, is occasionally rapid. Duhring alludes to a case where the disease ran its fatal course in a year.

Papillary variety.—In this variety of epithelioma, the lesion begins as a wart of split-pea size, or occasionally as a raised, lobulated, more markedly papillary formation of larger area. The surface is sometimes covered with dry, horny epidermic scales, at other times it is moist and macerated. There are usually fissures, secreting an offensive fluid, with sometimes cheesy, sebaceous matter. The fungous-looking granulated surface sometimes develops into fleshy protuberances, and at other times spreads out more flatly. After a time, it breaks down into a characteristic epitheliomatous ulcer running the usual course. Occasionally, the papillary growth proceeds from a pre-existing superficial or deep infiltrated ulcer.

Epithelioma is most commonly met with on the face, either on the lips or tongue, about the nose, the eyelids, the forehead and temples, or upon the scalp. The genitalia, especially the penis and scrotum in the male, and the labia in the female, are not uncommon seats of the disease. Epithelioma rarely occurs elsewhere, although it may be found in any part of the body. The lesion is usually single.

The exciting causes of epithelioma are often obscure. Epithelioma of the lip or tongue often starts at a point where the mucous membrane has been irritated by a pipe-stem or a jagged tooth. Warts and nævi, both pigmentary and vascular, are structures in which it often originates. The disease is commoner among men than among women.

Epithelial cancer generally takes its origin from the normal epithelium of the skin, mucous membrane, or glands. Compared with other varieties of carcinoma, epithelioma possesses a decidedly less degree of malignancy, and this a relatively local one.[1]

The diagnosis of epithelioma is usually not difficult excepting in the earlier stages. It may be confounded with syphilitic tubercles and ulcerations, acuminated warts and lupus. The papule or ulcer of epithelial cancer, especially if about the genitalia, may also resemble chancre; but the history of the case, the duration of the lesion and a careful examination of its features, will aid in arriving at a correct opinion. The later syphilitic manifestations run a much more rapid course, and change in appearance more rapidly than cancer, and when ulcerative, their secretion is much more abundant and purulent. Nevertheless, it is not rare in my experience to see cases of epithelioma about the face, which have been mistaken for the tubercular syphiloderm, or vice versâ. In making a diagnosis, the points just mentioned should be borne in mind, and also the facts that the tubercular syphiloderm, when ulcerating, usually shows several points of suppuration, while epithelial cancer is commonly single, and also that there is induration under and about the cancerous sore, while the syphilitic ulcer terminates abruptly against the sound skin. Finally, in cancer there is usually a picking and crawling sensation at first, and later lancinating pain. Syphilis is painless.

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[1] Dr. J. Collins Warren, of Boston, pointed out the true nature of rodent ulcer in his Boylston Prize Essay on the Anatomy and Development of Rodent Ulcer (Boston, 1872). Mr. Jonathan Hutchinson takes the same view in his Illustrations of Clinical Surgery, vol. i., Fasc. i., p. 14, London, 1875.

[1] For a careful and clear account of the pathology of epithelioma as at present understood, reference may be made to Duhring's Treatise, p. 517; also to the Essay on Cancer in the present work, Vol. I., p. 292.

Many epithelial cancers begin as warts, and it is often difficult to distinguish between a simple wart and a cancerous wart. Usually continued observation alone will decide. In elderly persons, any change in a wart of old standing upon the face, especially those flat brown warts not uncommon in advanced life, must be looked upon with suspicion.

From lupus vulgaris, the diagnosis of epithelial cancer is chiefly to be made by the history. Lupus is a disease of the young, and usually has a long history. It is apt to be found in more parts of the body than one. When ulceration takes place, the diagnosis becomes more difficult, but a careful examination of the surrounding parts will commonly show some characteristic lupus lesions in the neighborhood. The discharge from a cancerous ulcer is usually pale, scanty, and viscid, and is often offensive; that from lupus is yellowish and puriform, and is not offensive.

The treatment of epithelioma is external and local. The disease is to be removed as soon as a diagnosis is established. The knife, caustic, actual cautery, or galvanocautery may be employed as seems most advisable in the particular case. Care must be taken to remove the entire growth, and even to go a short distance into the surrounding healthy tissues. Small and superficial epitheliomata are, in my opinion, best removed by means of caustic potassa. The stick is to be rubbed over and around the malignant growth and bored into its substance. While operating, the unhealthy tissues are found to give way very readily, so that it may easily be perceived when the caustic reaches sound tissue. It must be remembered that the action of the potassa always proceeds a little farther after the caustic has been withdrawn. This must be borne in mind when operating in the neighborhood of important organs, as the eye, or where arterial branches may become involved. The application of the caustic potassa gives rise to severe pain, which however rapidly ceases after its withdrawal. When the effect has proceeded as far as is desirable, dilute acetic acid or weak vinegar applied on cloths, will neut
caustic influence and put an
end to the pain. There is
hemorrhage. The part oper
may be dressed with olive oi
soothing ointment. The dre
be changed daily, and the esch
falls off at the end of a week or
after which, a rapidly granulati
ensues, ending in an insignifica

Pyrogallic acid, in an ointm
strength of a drachm to the
plied on cloths from two to six
secutively, is a good remedy
cases, particularly when the p
not bear pain. It is usually pa
may have to be reapplied fro
time, the slough being scra
away as it forms.

Of the various other caustics
I can say nothing from pers
rience, but would refer to t
works on surgery in which t
scribed. Bryant[1] recommend
vapo-cautery, especially when
exists in localities where caus
knife cannot be employed with
as the inner canthus of the
dermal curette may sometim
ployed in small epitheliomata
use of the knife, which must
employed in the deeper and m
nant forms, reference should be
rules of operative surgery.

The prognosis of epitheliom
vorable, excepting in the small
ficial lesions. Relapses are a
place after operation.

SARCOMA CUTIS.

Sarcoma of the skin consist
pea, hazelnut, or larger sized
shaped, discrete, non-pigment
mented tubercles or tumors.
mented tumors, occurring as
multiple growths upon the
gions, represent perhaps the
manifestations of the disease.
smooth, firm, elastic, not mark
ful upon pressure; in color, re
laccous, or brownish-red. Th
pigmented sarcoma always ap
on the soles and backs of the
disease may be mistaken for th
syphiloderm, gummata, lupus,
It occurs generally toward mi
The disease is malignant, usuall
fatal in the course of a few year

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[1] Lancet, April 4, 1874.

[2] See Duhring, Treatise, p. 523;
glesworth (Archives of Dermatolog
No. 2); Hebra and Kaposi (Disea
Skin, New Syd. Soc. Translation,
and Köbner (Archiv für Derm. u. S
3, 1869).

NÆVUS VASCULOSUS.

Vascular nævi are congenital formations, composed chiefly of bloodvessels which have their seat in the skin and subcutaneous tissues. They may be prominent, turgescent, erectile, or even pulsating tumor-like growths (*angioma cavernosum*), or they may be flat, non-elevated, well-defined, or faint, smooth patches (*nævus simplex*). The latter is the "port-wine mark" or "claret stain" of popular nomenclature. Nævi occur of all sizes, from that of a small pin-head to hand-sized or larger areas. Their color may be of any shade of red. They are seldom multiple, and generally occur about the head, the lip being a favorite seat. They are usually stationary, but sometimes decrease as life advances; occasionally, on the other hand, in the erectile varieties, an increase in size is observed. They all become paler on pressure. The more prominent growths are markedly compressible.

The pathology of the disease varies somewhat in the different varieties. The flat nævus, or "simple angioma," is made up of a diffuse growth of new bloodvessels, chiefly capillaries, in the corium, especially the upper layers. In "lobular angioma" the bloodvessels are convoluted, the lobules being separated by more or less connective-tissue, which also exists in the cavernous form. Sometimes the nævus arises from the subcutaneous tissues, especially the adipose layer, constituting "angioma lipomatodes." Nævi are sometimes wart-like, and occasionally pigmented.

The treatment of nævi will depend upon the situation, form, and size of the growth in any given case. The principle of treatment is either bodily removal of the growth by means of the knife or ligature, or the excitation of plastic inflammatory action. The latter may be accomplished in any one of a number of ways. Minute pin-head-sized nævi may be destroyed by puncture with a red-hot needle, or a needle charged with nitric or glacial acetic acid, or with a needle connected with the positive pole of a four- to ten-cell combination of a constant-current battery. When the growth is a little larger, the size of a split pea to that of a small coin, it may be treated by caustic applications. Of these, the sodium ethylate, introduced into use by Dr. B. W. Richardson,[1] is one of the most efficient. It is made by adding metallic sodium to absolute alcohol. The pain caused by it, ordinarily not severe, may be allayed if necessary by the application of chloroform to the spot. The alcohol must be absolute, and the preparation should be fresh to ensure good results. It is to be applied by means of a glass rod. I have used it with great satisfaction. Other caustics are nitric acid, glacial acetic acid, and solution of caustic potassa. The two former I have frequently employed with good result. Injections with tincture of the chloride of iron, tincture of cantharides, and similar substances, as formerly practised, are to be condemned. Several fatal cases have, I believe, been reported where the tincture of iron was employed. Vaccination is sometimes employed with success. The virus is to be introduced by means of multiple puncture with needles.[1] Linear scarification, strongly recommended in flat nævi by Mr. Balmanno Squire a few years ago, has not been attended with success in other hands. Punctate scarification for the same form of nævus is recommended by Sherwell,[2] by means of an instrument composed of a number of fine needles arranged in a bundle, and charged with a caustic. Larger nævi may be operated on by electrolysis;[3] and the galvano-cautery has likewise been used with success, and is highly recommended by Drs. Dawson and Allen.[4]

Telangiectases are essentially the same as nævi, only instead of being congenital they make their appearance after the birth of the individual. They may be circumscribed growths or tortuous lines, composed in either case of enlarged capillaries. An example of telangiectasis is found in *rosacea*, often met with upon the nose, with or without acne.

The treatment of telangiectases is essentially the same as that of nævi.[5] Being quite small in size, they are usually amenable to the measures above described.

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[1] Lancet, vol. ii., 1878, p. 654, and Feb. 5th and 12th, 1881.

[1] Ragaine (Jahresbericht der Gesammt. Med., 1874) reports seven cases of erectile nævi cured by this means.

[2] Transactions of the American Dermatological Association; Archives of Dermatology, Oct., 1879.

[3] See papers by Carter, Lancet, Jan. 18, 1873; Penhall, Lancet, Apr. 11, 1874; Beard, Philada. Med. Times, Sept. 5, 1874; Knott, Lancet, March 20, 1875; Duncan, Edin. Med. Journ., Feb., 1876.

[4] New York Medical Record, vol. xi., 1876, pp. 11–12.

[5] See Hardaway, Transactions of the American Dermatological Association; Archives of Dermatology, Oct., 1879.

CLASS VII.—ULCERS.

(See Vol. I., p. 367.)

CLASS VIII.—NEUROSES.[1]

PRURITUS.

Pruritus is a functional cutaneous affection, manifesting itself solely by the presence of the sensation of itching, without structural alteration of the skin. The various forms of itching encountered in the course of many diseases of the skin, accompanied by organic changes, have been mentioned in connection with the diseases in which they occur. Pruritus, it must be remembered, is a distinct affection.[2] The single primary symptom is itching; there are no primary objective symptoms. Any lesions which may occur in the course of the disease are secondary, and the result of scratching. The sensation is variously described as a simple irritation of the skin, as if some rough substance, as flannel, were in contact with it, as formication or the crawling of minute insects over the surface, or as a tingling sensation, with the desire to scratch. It may be slight, or so severe as to be almost intolerable. It is most frequently met with in middle life and old age.

The itching arouses an irresistible desire to scratch and rub, with the result that the surface is generally seen to be slightly roughened, hyperæmic, and excoriated in a slight or marked degree. In other cases, the external signs are slight, so that were it not for the statement of the patient the presence of any marked disorder might be doubted. The itching is usually intermittent, and is always worse at night. Pruritus rarely invades the whole body at one time, though the various regions may in turn be attacked. In most cases it occurs in certain localities, and chiefly the trunk, scalp, genitalia, and anus.

Pruritus vulvæ must not be confounded with other pruriginous affections of the female genitals. The itchin
seated in the labia, vagina, or c
is an exceedingly distressing af
is more apt to occur in middle
In children it is often caused l
sence of ascarides in the re
about the anus.

Pruritus scroti is the form
met with in the male. It m
this region alone, or may exten
perineum to the anus. The o
urethra may also be the seat
ease. The sensations are
tensely annoying, and cause th
rub and scratch violently. It
night, and is aggravated by w

Pruritus ani occurs in both
in children, as well as adults.
ing may be around the orif
within the rectum. In midd
elderly persons it is very often
with hemorrhoids. It is, i
more intolerable than any o
local varieties. Sometimes it i
but more often it comes and
time to time, and is also worse

The causes of pruritus are
varied, and it is important to
mind, for the cause must, in n
be removed in order to attain
may be caused by physiologica
as gestation, or by any irregula
menstrual function in youn
Occasionally it is associated wit
and it is sometimes met wi
climacteric period. Leucorr
common cause. Organic dise
uterus and ovaries are at tim
panied by it. Pruritus is lik
with in course of certain othe
especially in those of the ki
liver. Diabetes mellitus is a n
mon cause. Pruritus is met wi
cases of jaundice, and is someti
tressing symptom. According
chison it is probably not cause
lation of bile-pigment. Vario
of the nervous system are ac
by pruritus. Gastro-intestinal
ment, constipation, genito-ur
eases in both sexes, and f
ingestion of certain medicine
opium, may give rise to the aff
would be hardly necessary to
not the mistake so often made
affection under discussion is i
caused by either vegetable o
parasites. When these are pr
by accident.

Pruritus is a functional affectio
due to reflex nervous action.
disturbance, unaccompanied by
change, constitutes the whole
The tissues remain unaltered th
the entire course of the disease.

The diagnosis of pruritus pr
difficulties. It is a disease of

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[1] Under the head of neuroses are usually grouped hyperæsthesia, dermatalgia, pruritus, and anæsthesia. Of these, pruritus alone is of sufficient importance to demand description in this article; for information regarding the other exceedingly rare neuroses of the skin, reference may be made to Duhring's Treatise, p. 539.

[2] Care must be taken on no account to confound pruritus with prurigo, a very rare affection of the skin, occurring first in childhood, and lasting through life, accompanied by the formation of shot-like papules. Prurigo seldom or never occurs in this country.

without primary sign of alteration in its structure. Whatever lesions may be present are secondary, and the result of scratching, or strong applications made by the patient. The diagnosis depends upon the patient's statement as to the subjective symptom of itching. Pruritus is most apt to be mistaken for pediculosis, the secondary symptoms of the two diseases, scratch-marks and excoriations, being similar. These, however, are more marked and definite in character in pediculosis. The finding of lice will settle the question. They are to be carefully looked for in the clothing, and every case of so-called pruritus should be suspected to be pediculosis until the absence of the parasites is shown.

The treatment of pruritus is a matter demanding careful consideration and study in each individual case. A successful result will, in most cases, only be attained by recognition and removal of the cause. Constitutional and local remedies are both demanded. The internal remedies are to be directed against the cause, whatever the nature of this may prove. If constipation exist, the bowels are to be suitably regulated, salines being usually preferable. If there is flatulence or dyspepsia of any kind, such a diet is to be prescribed as shall overcome the digestive difficulty, and coarse, irritating and indigestible foods are in all cases to be avoided. Exercise and fresh air are beneficial. A sojourn at some mineral springs, particularly those of Saratoga, may at times be recommended, when a course of the aperient waters, of which the Hathorn is the best, may be taken. In some cases close attention to these details will be followed by the most gratifying results. I may, moreover, give it as my experience, not only in the treatment of pruritus, but also of other skin diseases of a chronic and stubborn nature, that much depends upon the care and thoroughness with which the physician's directions, regarding matters of diet and regimen, are carried out. To ensure this the directions themselves must be full and perfectly explicit. The patient's case must be made the subject of careful study, the exact diet suitable to the individual must be decided upon and enforced in such terms as to leave no doubt in the patient's mind as to the importance of every detail. Generalities in the way of directions, with a careless indication in broad terms, of the articles of diet to be used and avoided, are not likely to produce a serious impression on the patient's mind, and the failure to amend is followed by a general despondency and distrust of all remedies.

As regards drugs, the usual tonic and alterative medicines are to be employed. Irregular menstruation must be treated by the judicious use of iron or other remedies, cod-liver oil, etc. Quinia and strychnia are sometimes of use. Recourse may be had to bromide of potassium and chloral, alone or together, in order to subdue general nervous symptoms. Morphia should in no case be used, as it tends to aggravate the itching. Bulkley[1] has recently called attention to the tincture of gelsemium.

The external treatment is not ordinarily to be looked upon as curative, but affords great relief, and is to be employed in all cases. Water, in the form of cold and hot douches, or alternately cold and hot, as hot as the skin will bear, plain vapor-baths, and medicated baths will often prove serviceable in allaying the symptoms. Baths containing three to six ounces of bicarbonate of sodium, or two to four ounces of carbonate of potassium or of borax, to thirty gallons of water, will at times afford relief. Sulphuret of potassium, from one to four ounces to the bath; and sulphur-vapor-baths are sometimes used with success. Some bland oil, as oil of sweet almond, or olive oil, or some soothing ointment, may be used after the bath.

Lotions of various kinds are the most generally useful applications in pruritus, and those containing carbolic acid are by far the most generally efficient. In my opinion carbolic acid is worth all the other remedies put together, and it should always be preferred to begin with unless some reason exists against its use. It may be employed in lotion in the strength of five to twenty grains to the ounce of water with a little glycerine. The following is a favorite formula of mine:—

℞. Acid. carbolic., ʒiij.
Glycerinæ, f℥j.
Aquæ, Oj. M.

Duhring suggests the following lotion, in which the anti-pruritic effect of potassa is added to that of carbolic acid:—

R. Acidi carbolici, ʒj.
Potassæ fusæ, ʒss.
Aquæ, f℥viij. M.

Duhring is also in the habit of using thymol with satisfaction. Bichloride of mercury, half a grain to two or three grains in the ounce of water or alcohol, is an old and well approved application. Black wash and lime-water may likewise be used. Folsom recommends essence of peppermint when other remedies fail; and Taylor[2] suggests its employment mixed with an equal quantity of glycerine,

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[1] New York Medical Journal, Jan., 1881.

[2] On the various forms of Pruritus Cutaneus and their Treatment. Archives of Clinical Surgery, Aug., 1877.

and painted on the part with a brush. Morphia, from one to three grains to the ounce; cyanide of potassium, from fifteen to thirty grains to the pint; sulphate of sodium, a drachm to the ounce; dilute hydrocyanic acid, from one to four drachms to the pint; chloroform; chloroform and alcohol, a drachm to the pint; lead-water; diluted water of ammonia; dilute nitric acid; acetic acid; and chloral lotion, ten to thirty grains to the ounce of water, are all serviceable remedies which may be tried singly or in succession in troublesome cases.

Dr. R. W. Taylor, in his paper above referred to, recommends the following:—

℞. Fol. belladonnæ,
Fol. hyoscyami, āā ʒij.
Fol. aconiti, ʒss.
Acidi acetici, ℥j. M.

The leaves must be reduced to a tolerably fine powder, and then mixed with the acid and allowed to macerate two weeks.

This should be diluted with water, a drachm to the ounce.

The "liquor picis alkalinus," devised by Dr. Bulkley, the formula for which has been given under the head of eczema, is a most valuable remedy. It should be used at first in the strength of two or more drachms to the pint of water, gradually increasing. The "liquor carbonis detergens" is also a good remedy.

In some forms of the disease, particularly the more localized forms, ointments are better than lotions; the following is a good one:—

℞. Acid. carbolic., gr. x ad xv.
Ung. zinci oxidi, ℥j. M.

The following is recommended in pruritus vulvæ:—

℞. Ung. cetacei, ℥j.
Hydrarg. chlor. mitis, ʒss.
Ext. belladonnæ, ʒj. M.

Dr. Bulkley has also introduced the following excellent formula to the notice of the profession:—

℞. Camphoræ,
Chloralis hydratis, āā ʒj.
Ung. aquæ rosæ, ℥j. M.

The camphor and chloral are to be rubbed together until fluid, and then added to the ointment; the mixture may also be used with vaseline, or as a lotion with glycerine and water. Care should be taken not to apply this ointment to abraded surfaces, as it gives rise to considerable pain.

In pruritus of the female genital organs, lotions are generally preferable. Hot water is often very useful. Decoction of tobacco, two drachms of the leaf to the pint is recommended highly by Atthill and Goodell. Sulphurous acid is valuable. Alum, fifteen or twenty grains to the pint of decoction of barley, will sometimes be found useful. A prescription containing sulphite of sodium, one drachm; water, four drachms; and glycerine, one ounce, pencilled upon the parts, may also be used. Dr. Wiltshire, in a excellent lecture, giving a *résumé* of recent knowledge on the causes and treatment of pruritus vulvæ,[1] says that demulcent washes, particularly those containing almond-meal, which evolves a small quantity of hydrocyanic acid, are very soothing.

Pruritus ani is generally best treated by means of ointments. Bulkley recommends equal parts of mercurial ointment and belladonna ointment applied upon a pledget of lint. When there are fissures, pencilling with a solution of the nitrate of silver will often prove beneficial. The application of hot water, as hot as can be borne, applied with a soft linen compress, will itself sometimes afford ease. I ordinarily suggest this as a preliminary in every case, following it up with inunctions of tar ointment, in the strength of one or more drachms to the ounce of cold cream. In pruritus scroti, Bulkley states that he obtains good results from the following prescription:—

℞. Bismuthi subnitratis, ʒij.
Acidi hydrocyanici, fʒij.
Mist. amygdalæ, f℥iv. M.

Dr. Legg prefers mercurial ointment, ung. hydrarg., and ung. hyd. ammoniat., in the pruritus of jaundice. The late Dr. Murchison valued lotions of chloroform (one drachm to five of glycerine), and cyanide of potassium (one drachm to the pint), and acetic baths or lotions, in the strength of half a pint of the acid to three gallons of water.

The prognosis of pruritus should be guarded. The disorder as a rule is obstinate, and often extremely so. The prognosis depends largely upon the cause and the ability to remove it. The patient must be encouraged to persevere with and thoroughly carry out the treatment. In grave cases, melancholic symptoms may be present. Occurring in the aged, the prospect of ultimate cure is poor. In the middle-aged, pruritus vulvæ is apt to be the most stubborn variety; as Duhring says, the affection is a most distressing one, and calls for every effort on the part of the physician.

PRURITUS HIEMALIS (Winter pruritus).—Under this name Dr. Duhring described for the first time,[2] a peculiar form of pruritus dependent upon atmospheric influences, and occurring chiefly in cold weather. It usually makes its appearance in October, and lasts until spring, being worse in clear frosty weather, and disappearing at times if the weather becomes warm and moist. It occurs chiefly on the inner surfaces of the thighs, about the knees, the calves and ankles. The affection may be relieved, but not usually cured. Emollient ointments, as vaseline and glycerine, with alkaline baths, give most relief. The under-garments should be soft and unirritating.

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[1] Clinical remarks on the diagnosis and treatment of pruritus vulvæ. British Medical Journal, vol. i., 1881, p. 327.

[2] Phila. Med. Times, Jan. 10, 1874.

CLASS IX.—PARASITES.

(1) VEGETABLE PARASITIC AFFECTIONS.

TINEA FAVOSA.

Tinea favosa is a contagious vegetable parasitic disease, due to the achorion Schönleinii, characterized by discrete or confluent, split-pea-sized, circular, cup-shaped, pale-yellow, friable crusts, usually perforated by hairs, accompanied by itching. The disease usually attacks the scalp,[1] but may now and then be encountered in the nails, and less frequently on other parts of the surface. It shows itself at first by diffused or circumscribed superficial inflammation with slight scaling, followed by the appearance of one or several pin-head-sized pale-yellow crusts seated about the hair follicles, which develop into the characteristic lesions of the disease, raised, sulphur-yellow cups, which can be detached from the skin underneath, leaving a moist excoriated surface, and can be powdered between the fingers. When the disease is extensive, ulceration may exist under the crusts. When the nails are attacked, they become thickened, yellow, opaque and brittle. Tinea favosa possesses a peculiar odor, so characteristic that this alone is sufficient to indicate its presence. It is that of mice or stale straw. The disease gives rise to some, but not to excessive itching.

The hairs in tinea favosa of the scalp become lustreless, opaque, dry, brittle, and at times split longitudinally. After the disease has existed some time, they fall out, or are pulled out, leaving bald patches, which in many cases are permanent. When there is ulceration, a cicatrical condition of the scalp may ensue. Tinea favosa is a chronic disease, and unless properly and energetically treated, may last a lifetime. Relapses are apt to occur.

The cause of tinea favosa is found in the presence and growth of a vegetable organism, named after its discoverer Schönlein, of Berlin, the achorion Schönleinii. It is an exceedingly contagious disease, and exists among domestic animals, particularly mice, rabbits, and cats, from whom it is conveyed to man. It is commoner among children than in adults. It is rare among cleanly people, and is not so frequent in the United States as among the degraded and filthy populations of European countries.

The disease may have its seat either in the hair-follicle or hair, or upon the surface of the skin; the follicle and hair are the structures usually attacked. It is a local affection, and is due solely to the presence of the parasite, the characteristic crusts being almost entirely made up of this fungus. If a morsel of one of the cups is ground down with a little water, placed a microscopic slide with the addition a drop of dilute liquor potassæ and examined, the characteristic spores and mycelium can be observed without difficulty. The disease, when it attacks the nail, may readily be detected by examining some scrapings under the microscope, though the growth is seldom so luxuriant as in the skin and hair. The achorion Schönleinii is a distinct variety of fungus, and is capable of giving rise to one form of disease only, namely tinea favosa.

The diagnosis of favus is usually easy; the peculiar yellow cups and the odor are commonly present, and even when the shape of the cups has been lost by suppuration, or broken down by treatment, a patch of characteristic color can usually be seen here or there. The odor is almost always perceptible, and I have frequently diagnosticated cases by this alone. In rare cases, tinea tonsurans or circinata may coexist with the disease. The microscope should be used in doubtful cases; a power of 250 to 500 diameters is required.

The treatment of favus of the body is comparatively an easy task, but when the disease is firmly rooted in the scalp, it requires both patience and long perseverance to make successful headway against it, and to finally extirpate the last traces of the fungus. The two remedies are depilation and parasiticides.

The hair is to be cut as short as possible, after which the crusts are to be removed with poultices or applications of olive or almond oil, and soap and hot-water, as in the case of pustular eczema of the scalp. After they have been removed, the scalp, in severe cases, will baldness, or patches of superficial ulceration resembling the effects of syphilis. Depilation is then to be practised either with a pair of flat-bladed forceps especially made for the purpose c means.[1] A small surface cleared each day.

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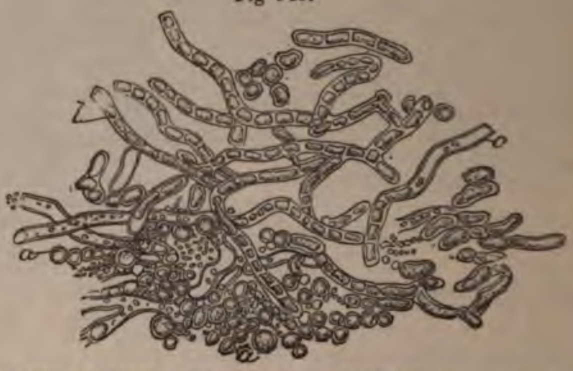
[1] See Duhring's Atlas, Plate O.

Immediately after the opera

Fig 940.



Fungus of favus (Achorion Schönleinii) after treatment with liquor potassæ. *a* Spores. *b*. C terminating the filaments of the thallus, which are there composed of short articulations. *c*. of the thallus composed of elongated and brilliant articulations. × 400. Cornil and Ranvier.

show pits and depressions with atrophy, asiticidal lotion should be rubbed in and made to penetrate the hair follicles. Corrosive sublimate, in the strength of two or three grains to the ounce, is one of the best parasiticides. Sulphite of sodium, one drachm to the ounce as a lotion; sulphurous acid, full strength or diluted, as a lotion. Among ointments sulphur, a drachm or more to the ounce of ung. aquæ rosæ; the yellow sulphate of mercury, half a drachm or more to the ounce of ointment; and chrysarobin in the same strength, may be mentioned. The latter must be used with caution on account of its occasional excessive effect on the surrounding healthy skin and in discoloring the hair. Tar may occasionally be added to the other preparations when there is much itching.

The length of time requisite to obtain a cure in tinea favosa will depend greatly upon the severity and duration of the disease, and the facilities for treatment which are afforded. Duhring gives two to four months as the average time, but I should be inclined to extend this. Cleanliness is requisite and attention to general hygiene; also in some cases tonics. In long-continued favus of the scalp, more or less baldness of a permanent character ensues. Favus of the epidermis is seldom obstinate.

TINEA TRICHOPHYTINA.

Under this name are included three varieties of disease, known as tinea circinata, tinea tonsurans, and tinea sycosis, all produced by the same fungus, and therefore to be regarded as the same disease, modified by in which it may chance to occu

TINEA CIRCINATA is a conta table parasitic disease, due to phyton, characterized by one or more circumscribed, circular, variously-sized, inflammatory squamous patches, occurring on the general surface of the body, accompanied by itching.

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[1] See Bulkley: Clinical Illu Favus and its Treatment by a Ne Depilation. Archives of Derma vii., No. 2, April, 1881. Dr. ploys masses or sticks like thi sealing wax of a very adhesive ma can be melted and made to adhere and then when cold are forcib drawing numbers of hairs with following is the formula:—

℞. Ceræ flavæ, ʒiij.
Laccæ in tabulis, ʒiv.
Resinæ, ʒvj.
Picis Burgundicæ, ʒx.
Gummi Dammar, ℥ss.

The ingredients are melted t moulded or rolled into sticks of v from one quarter to three-quarter in diameter, and cut off in length three sizes. The end of the sti melted in an alcohol flame, and t upon the hair, cut to a length of of an inch. It is left on until qu is then removed by bending it ove drawing the hairs by a slight twist When the stick is removed its found bristling with hairs. The stick is then melted again in the al and wiped on a sheet of paper stroys and removes the hairs and for use again. Depilation by this very much more rapid than when are pulled out one by one with t but it is painful and requires mu on the part of the patient.

Ringworm of the body varies greatly in importance, from the trifling disease so commonly found among children, to those severe and extensive forms known as Burmese or Tokela ringworm, tinea imbricata,[1] and by other designations. The "eczema marginatum" of Hebra is a severe form of ringworm occurring in the fork of the thighs.

Tinea circinata usually begins as a small reddish, scaly, rounded, or irregularly-shaped spot, which in a few days, as the process advances, assumes a circular form, attended either by an increased branny desquamation, or by the formation of minute papules, papulo-vesicles, or vesicles around the circumference of the lesion. When fully developed, the patches are circular, slightly elevated, and sharply defined against the healthy skin outside. The tendency to assume the annular character which has given rise to the term ringworm, is due to the fact, that the disease is disposed to disappear wholly or in part in the centre while spreading at the periphery.

The lesions may vary from small coin to hand-sized patches. They sometimes coalesce in part, so as to form gyrate or festooned figures. Often only one or two are present, and these may be situated in different parts of the body. They are bright or dull reddish in color, paler in the centre, and are, as a rule, only scantily covered with scales. The vesicles, papulo-vesicles, or papules, where these exist, are pin-point to pin-head in size, and are situated on the periphery. They are often ephemeral, and may easily escape detection. The lesions are superficial, the corium only rarely, and in severe cases, being attacked. The disease is unsymmetrical, but is apt to be found in contiguous parts, having been transferred from one part to another. All parts of the body may be attacked, but the disease is most apt to be found about the face, neck, and backs of the hands. The axillæ, the inner surface of the thighs, the groins, and between the nates are also common seats of the affection in adults. In these localities it is apt to spread extensively and to prove rebellious. The more inveterate forms of ringworm are found in tropical countries. As the disease is found in America, it is usually not severe. Its course is variable, sometimes lasting only a few weeks, at other times persisting and recurring with great obstinacy. It occasionally coexists with tinea tonsurans.[1] Now and then the tricophyton attacks the nails, which become opaque, whitish, thickened, and soft or brittle, especially along their free border. Examination of scrapings from the nail treated with dilute solution of caustic potassa will show the presence of the fungus. The affection usually attacks only two or three nails; it is difficult to cure.

Ringworm of the body is caused by the presence of tricophyton, the same fungus as that which produces tinea tonsurans and tinea sycosis. It seldom grows with the same luxuriance, however, as is shown in these diseases. The affection is eminently contagious. Several members of the same household are apt to have it at the same time. It may also be contracted from the domestic animals. All persons are not susceptible to the same degree, and there seems to be a condition of the system in which the fungus more readily takes root and flourishes.

The fungus alighting on the surface penetrates the epidermis and spreads in all directions, giving rise by the irritation of its presence to hyperæmia, superficial inflammation with papulation, and sometimes to vesiculation. Under the microscope, the fungus is seen to consist of long-jointed, sometimes forked, thread-like mycelium, containing spores or granules. Its botanical relations have been carefully studied by Dr. I. E. Atkinson, of Baltimore.[2]

The diagnosis may be determined either by the clinical features of the disease, or with the aid of the microscope. In the latter case a few scales may be scraped from the surface of a diseased patch, placed on a slide with a drop of dilute liquor potassæ, and covered with a thin glass, which should be pressed down so as to separate the particles. Viewed with a power of 250 to 500 diameters, the characteristic long mycelial threads may usually be seen becoming more distinct after the specimen has stood for a while. The mycelial threads must not be confounded with fibrils of wool, cotton, etc., which are apt to be met with in the field, and the spores, which are usually less plentiful, must be carefully differentiated from oil-globules derived from ointments, etc. It should be said that the failure to find the fungus must not be allowed to weigh too much in the diagnosis, though its positive presence is conclusive. The

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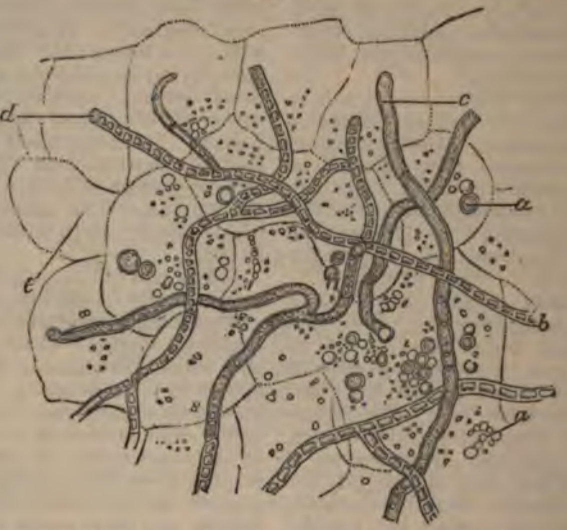
[1] See Fox and Farquhar, On Certain Endemic Skin- and Other Diseases of India and Hot Climates Generally, pp. 59, 246. London, 1876.

[1] See Duhring's Atlas, Plate EE.

[2] In a paper read before the American Dermatological Association, in 1878. New York Medical Journal, Dec., 1878.

Fig. 941.



Trichophyton tonsurans, obtained from tinea circinata. *a*, Spores. *b*, *d*, Filaments of the mycelium, consisting of short articulations. *c*, Filaments of the mycelium, consisting of long and streaming articulations. *e*, Cells of the epidermis. × 400. (Cornil and Ranvier.)

fungus is sometimes rare and difficult to find in mild cases, or where treatment has been employed.

Tinea circinata may be mistaken for eczema. It may resemble the erythematous, papular, vesicular, or squamous varieties, especially the latter. Its annular form and abrupt well-defined edges, its superficial character, and comparatively slight infiltration, its generally slight and shreddy desquamation, and its history, will usually serve to distinguish ringworm, and when the fungus is found to be present the diagnosis will be certain. Tinea circinata also resembles seborrhœa of the chest and back, the patches of the latter affection not unfrequently assuming a curious annular form in these localities. The patches of seborrhœa, however, are redder, with enlarged follicles, and the scales are more or less greasy. Ringworm often resembles psoriasis very closely, but the latter affection is usually more extensive in its distribution, and by examining the eruption in all places where it occurs, some patches may almost always be found which are characteristic.

As a rule, local treatment alone is required, but sometimes, when patients are evidently out of health, or when the affection is rebellious to parasiticide applications, tonics, as iron, arsenic, quinine, and cod-liver oil may be required. In most cases, however, local treatment will be found easily and readily to cure the disease. To begin with, the patient's clothing should be disinfected by baking or boiling, as the disease may arise anew from this source, as in the case of a coat-collar, etc. The affected patches of skin should be cleansed with hot water and soap to remove all extraneous matter, and then, in children, an ointment of ammoniated mercury, fifteen to thirty grains to the ounce, will usually be sufficient in mild cases. When stronger applications are required, sulphurous acid, in the form of a lotion, hypo-sulphite or sulphite of sodium, a drachm to the ounce, as lotion or ointment, are serviceable remedies. An efficient parasiticide in obstinate cases is chrysarobin, ten to forty grains to the ounce of ointment; it stains the skin and clothing, however, and sometimes causes inflammation if used incautiously, and should, therefore, only be employed when milder applications have failed. The same may be said of pyrogallic acid, excepting as regards the staining and inflammation, which are less likely to occur. Care should be taken not to excite undue irritation and inflammation, which are unnecessary, and delay the cure. In obstinate tinea circinata cruris, the late Dr. Tilbury Fox recommended the following combination, which is endorsed by Duhring:—

℞. Creasoti, ♏xx.
  Olei cadini, fʒiij.
  Sulphuris sublimati, ʒiij.
  Potassii bicarbonatis, ʒj.
  Adipis, ℥j.
M. ft. ungt.

Other remedies might be mentioned; indeed, pages could be filled with the enumeration of those which have been recommended; the fact being that any and all are efficient, and the choice lies with those which shall cure the individual case most quickly and with the least annoyance and disfigurement to the patient.[1]

The prognosis of tinea circinata is always favorable, with a marked difference in the time required between the milder, almost spontaneously curable cases, and those where the eruption tends to constant recurrence.

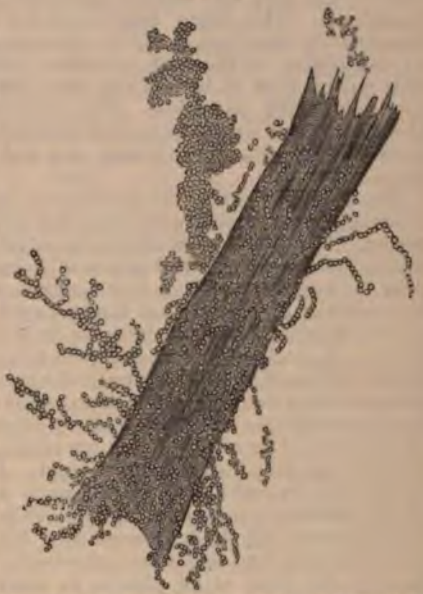
TINEA TONSURANS is a contagious, vegetable parasitic affection of the scalp due to the tricophyton, characterized by one or more usually circular, variously-sized, scaly, more or less bald patches, showing the hair to be diseased and usually broken off close to the scalp, accompanied by itching. When fully developed the scalp is more or less raised and puffed out, and the follicles as a rule prominent, giving the surface a goose-skin or "plucked fowl" appearance, which is characteristic of the disease, and is most marked after the hairs have fallen out. The hairs are uniformly short, uneven, stubble-like, looking as if nibbled off, and pretty uniformly about a twelfth to a sixth of an inch in height. They are brittle, and tend to break off when the attempt is made to extract them. Later they drop out of their own accord. There is generally a certain amount of powdery scaliness in the patches. These are rarely larger than a silver dollar. Baldness of a temporary character is apt to result in the patches.[2]

Another form of ringworm of the scalp is the disseminated form, where, at first sight, only a little diffused scaliness exists, but careful examination, especially with a lens, which should always be used in suspected cases, shows numerous scattered stumps and black spots where the diseased hairs have broken off short. Tinea tonsurans is often associated with tinea circinata, the patches sometimes running from the scalp on to the face or neck. The two affections, it must be remembered, are due to precisely the same fungus.

Ringworm of the scalp is a disease of childhood, being rarely met with after puberty. It is highly contagious, and may readily be communicated from one child to another by means of wearing apparel, caps, combs, brushes, towels, and bed-linen. It is very apt to occur in children's asylums and in schools, where a number of inmates may become affected at the same time, and where its complete eradication is a matter of extreme difficulty.

Although the fungus of tinea tonsurans is the same as that of tinea circinata, yet the microscopic appearances are somewhat different, owing to the fact that while the mycelium threads fill the field in the latter, the spores are most numerous in ringworm of the head, infiltrating the hairs in long chains, and splitting the structure apart, giving a brush-like appearance to the broken extremities of the hairs.

Fig. 942.



Fungus of tinea tonsurans (trichophyton) (Hillier). Low magnifying power. The spores are the same size as those of fig. 941.

In the majority of cases the diagnosis is easy. The presence of numerous follicles deprived of their hairs, the blackish dots marking apertures of follicles containing broken-off hairs disseminated over a partly bald surface, and especially the occurrence of stumpy hairs an eighth of an inch in height, more or less, is suspicious. A history of contagion can often be obtained. Eczema squamosum is the disease most apt to be confounded with ringworm of the scalp, but a careful examination of the points above noted will usually settle the question. A lens should be used in a strong light in doubtful cases. The microscopic examination, which should always be undertaken when practicable, offers no difficulty. One or two of the short stumpy hairs should be placed on a slide with a drop of liquor potassæ, and permitted to stand a few minutes, when, under a power of 250 diameters, the fungus will be plainly visible. It is useless to examine the long hairs, as they rarely contain any fungus.

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[1] Some excellent hints upon treatment may be found in a little book by Dr. Alder Smith, Ringworm: its Diagnosis and Treatment, Am. ed., Philadelphia, 1881.

[2] See Plate EE, Duhring's Atlas of Skin Diseases.

The general treatment is essentially the same as for ringworm of the body, considering only the altered anatomical conditions. The same tonics are also occasionally required. Strict attention to cleanliness is the first requisite, not only with a view to hasten the cure, but also to prevent contagion. The patient should be provided with special wearing apparel, combs, brushes, towels, and bed-linen.

The patches should first be cleansed as thoroughly as possible with soap and hot water. The loose hairs about the edges of the patches, and the broken-off hairs over the surface, are then to be extracted by means of a broad-bladed forceps, such as are obtainable for the purpose in the shops. A portion of the diseased hairs are to be removed each day until the surface has been cleared. After each depilation a parasiticide is to be applied, whether in the form of an ointment, oil, or lotion, as may be considered most proper. I think that in cases where the disease is at all generally diffused through the scalp, it is better to clip the hair close over the whole surface, and apply the parasiticide in a milder form at all points, in order to prevent contagion and the establishment of the fungus. For it is much easier to eradicate the tricophyton when it has freshly settled upon the surface, and before it has had time to extend into the hair follicles.

Among local remedies, corrosive sublimate in ointment, two to five grains to the ounce, or as a lotion, one or two grains to the ounce of water or alcohol, answers well according to most writers. I have never used it, and would suggest caution in its employment over large surfaces in young children. Carbolic glycerine, as recommended by Alder Smith,[1] I have found an excellent remedy. Smith recommends it in the strength of one part of carbolic acid to one to six of glycerine, according to the age of the patient and the extent of the disease. I usually employ a stronger lotion to the patch, and a weaker one to the scalp generally, as a preventive of contagion.

An ointment highly recommended by Alder Smith is the following:—

℞. Acidi carbolici,
Ung. hydrarg. nitrat.,
Ung. sulphuris, āā ℥ss. M.
Ft. ung.

The ingredients are to be mixed without heat. This ointment may be used in children over eleven years of age. Under this age it is advisable to use a double proportion, or even more, of the sulphur ointment. This may be used once a day over the entire scalp, the patches themselves being rubbed twice daily.

When the disease is confined to a small area and proves rebellious, the artificial production of tinea kerion, by means of the cautious application of croton oil, will found valuable. The part should be painted with the oil every day until inflammation is set up, and then poulticed and depilated.[1] Among the milder remedies, sulphurous acid in full strength; sulphuret of potassium, thirty to sixty grains to the ounce; hyposulphite of sodium, one to two drachms to the ounce; or sulphite of sodium in the form of ointment, a drachm or more to the ounce, may be employed. In disseminated ringworm of the scalp, oleate of mercury,—a five per cent. solution in children under eight years of age, and a ten per cent. solution in older children, is recommended by Smith. The oil is to be rubbed in nightly with a sponge-mop, care being taken not to allow it to run over the face; a cap should be worn at night. Whatever means be used, they should be employed with great care and thoroughness, for in no skin-disease more than this is it the case that the difference between success and failure may depend upon the care with which the physician's instructions are carried out. Spontaneous cure may take place, although, as a rule, the disease when left to itself tends to run on indefinitely.

Tinea kerion is an inflammatory and suppurative form of tinea tonsurans, characterized by œdema, inflammation, and the exudation of a viscid, glutinous, yellowish secretion from the openings of the hair-follicles. It begins as ordinary tinea tonsurans, and is followed in a short time by tumefaction and deep-seated subacute inflammation. When fully developed, the patches are smooth, yellowish, reddish, or purplish, more or less raised, œdematous, and boggy. They are honeycombed and studded with yellowish suppurative pits, the openings of the distended hair-follicles deprived of their hairs, which discharge a mucoid, gummy, honey-like fluid. The patches are apt to be tender and painful; they sometimes itch and burn. In severe and protracted cases the hair-follicles are destroyed, and baldness results. The course of the affection is chronic, and it may continue indefinitely unless checked. The usual treatment for tinea tonsurans is appropriate. Duhring prefers sulphurous acid.

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[1] Loc. cit.

[1] See Alder Smith, loc. cit.

TINEA SYCOSIS is a contagious vegetable parasitic affection, due to the tricophyton, confined to the hairy portion of the face and neck in the adult male, characterized by disease of the hair and hair-follicle, inflammation of the skin and subcutaneous connective-tissue, and the formation of tubercles and pustules. The disease usually begins with slight redness and scaliness as tinea circinata, but in a few days the hairs begin to be affected; they become dry, brittle, and sometimes loose, the skin becomes nodular and lumpy, with points of pustulation about the hair-follicles. The deeper tissues become involved later, and thick raised masses of induration of a dusky reddish or purplish color appear, giving rise to considerable disfigurement; the rapidity of development is sometimes remarkable. The tubercular formations are characteristic of the disease; they vary from pea to cherry size, and often coalesce into uneven lumpy patches which may cover considerable surface.[1] In rare cases the lesion may be single, coin-sized, sharply circumscribed, and prominently raised, as much as half an inch. The amount of suppuration varies. In my experience it is usually comparatively slight, though now and then profuse, and taking the form of pustular eczema, which may hide the real nature of the disease. Beneath the crusts which then form will usually be found an uneven, moist or excoriated, reddish surface, with yellowish points, discharging a glairy, glutinous material, and resembling in appearance the cut surface of a fig (whence the name sycosis). The hairs are diseased, dry, brittle, and broken, as in tinea tonsurans, and may be plucked out with ease. Later in the course of the disease they drop out spontaneously. The chin, neck, and submaxillary region are the localities commonly attacked; the upper portion of the cheeks and upper lip are rarely invaded. The amount of itching, burning, and pain varies; these symptoms are in most cases by no means so severe as in non-parasitic sycosis. The course of the disease is usually chronic; when left to itself it may last for months or years. Unless thoroughly treated it tends to relapse.

The cause of tinea sycosis is found in the presence and growth of the tricophyton. The only difference between this and tinea tonsurans lies in the difference of the anatomical structures attacked. It is eminently contagious, and is acquired in most cases at the hands of the barber. It is not a common disease.

Under the microscope the affected hairs are seen to be swollen, and at times twisted and disintegrated about their roots. The fungus shows itself in the form of a small number of mycelial threads with numerous spores, as described under tinea tonsurans.[1]

Considerable difficulty is sometimes experienced in distinguishing between tinea sycosis and sycosis non-parasitica.[2] There are certain marked differences, however. In tinea sycosis the skin and subcutaneous tissue are involved, as is shown by the upheaval of the large dusky red lumps, while in sycosis non-parasitica the trouble is more superficial and lies around the hair-follicles, each hair growing out of a pustule, but the general texture of the skin not being markedly infiltrated or swollen. The inflammation is also acuter and more active in the non-parasitic disease, and is followed by free suppuration, while in tinea sycosis it is deeper, less active, and attended by less suppuration. In sycosis non-parasitica the pain and burning sensations are at times very severe. Neither of these symptoms is as a general thing marked in parasitic sycosis. The upper lip is rarely attacked in tinea sycosis; it is very frequently attacked in sycosis non-parasitica. The hairs in parasitic sycosis are loose, and come away without pain; in non-parasitic sycosis they give great pain when pulled out, excepting when free suppuration about their roots may have loosened them.

From pustular eczema the disease under consideration is distinguished by the absence of the burning, itching, and symptoms of acute inflammation characteristic of the former disease, as well as by the other characteristics mentioned above. From the vegetating hypertrophic syphiloderm, which it sometimes resembles, tinea sycosis is to be distinguished by the history, and by the absence of ulceration characteristic of syphilis in this form. The microscopic examination of the hairs, which should be undertaken in all questionable cases, will clear away all doubt.

Depilation and the use of parasiticides are both demanded in treatment. The hairs can usually be extracted without giving pain. If diseased they come away easily; if not easily loosened they are generally better left alone. When crusts exist, these should first be removed by soap and hot water, or by poulticing. The parasiticide should be applied immediately after depilation in order to produce the best effect. Those remedies mentioned under the head of tinea circinata and tinea tonsurans may be employed. Duhring advises the use of the yellow sulphate of mercury, thirty grains to the ounce of ointment, and also recommends sulphurous acid or lotions of sulphite or hyposulphite of sodium. These are to be applied thoroughly, so as to penetrate the hair-follicles, twice or thrice daily. I have used very successfully in several cases an ointment of chrysarobin, thirty grains to the ounce. The usual precautions against undue irritation of the surrounding skin and against staining the clothing, etc., must be taken where this remedy is employed.

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[1] See Duhring's Atlas of Skin-Diseases, Plate S.

[1] See an illustration in Duhring's Treatise, p. 587.

[2] It should not be forgotten that tinea sycosis is true "barber's itch;" and that the far commoner disease, sycosis non-parasitica is *not* contagious.

The disease is sometimes rebellious; one or two months may be required for a cure. Relapses are apt to occur if the treatment is not very thorough.

TINEA VERSICOLOR is a vegetable parasitic disease, due to the *microsporon furfur*, characterized by variously-sized, irregularly-shaped, dry, slightly furfuraceous, yellowish, macular patches, occurring for the most part upon the trunk, in adults. The disease begins by the formation of pin-head- and split-pea-sized yellowish spots, usually scattered here and there over the affected region. These grow gradually larger, and coalesce, forming hand-sized and even extensive patches, with extremely irregular margins, sharply defined against the sound skin. There may be only a few patches, or on the other hand the disease may be quite extensive. The patches are usually the seat of desquamation to a greater or less extent. In cool weather the disease ordinarily gives little discomfort, but in hot weather, and especially when the patient perspires freely, much itching is sometimes experienced. In some cases, however, no itching is experienced at all at any time. The chest and back are the parts usually and chiefly affected, the disease also spreading down the flanks and over the buttocks and abdomen and groins. The thighs and arms are also often involved, but the disease rarely extends above the trunk or below the elbows or knees. Practically it is an affection of the trunk, which often presents a mapped appearance, owing to the peculiar and irregular configuration of the lesions.[1] The course of the disorder is variable; at times it spreads rapidly, in other cases very slowly. It is, as a rule, a persistent disease. Without treatment it may continue for an indefinite period; I have seen cases where it has existed for from ten to fifteen years. Relapses are not uncommon, even when the treatment has been most judicious.

The cause of the disease is found in the presence on the skin of a vegetable growth called the Microsporon furfur.[1] The affection is contagious, although only in a very low degree, and only under favorable conditions, as when two persons sleep habitually in the same bed. Its contagious properties are much less than those of the other vegetable parasitic affections. Tinea versicolor rarely occurs before puberty or after fifty. I am inclined to think it common among weakly persons. It is usually detected among those who are suffering from chronic thoracic disease; but this may result from the fact that such a trifling affection is very apt to be passed unheeded, and is only accidentally discovered in physical examination.

The microsporon furfur consists of mycelium and spores, the former being made up of variously-sized, usually short, threads, which cross each other, forming a sort of network, while the spores are mostly arranged in groups, so as to roughly present the appearance of bunches of grapes. The microscopic examination may be made by scraping off some of the furfuraceous epidermis, and adding a drop of dilute liquor potassæ on the slide. The appearance of the fungus, which is luxuriant, is striking and characteristic; once seen it is never forgotten.

The diagnosis of tinea versicolor is not usually difficult, the microscope always serving to decide doubtful cases. The seat of the disease is chiefly upon the trunk, and always there whether elsewhere or not. The slight furfuraceous scaliness, the comparative freedom from itching when the patient is cool, with the increase of this symptom when sweating, or in hot weather, are all distinctive signs. From vitiligo, tinea versicolor is distinguished by the fact that the *patches* in the former affection are white, and the surrounding skin darker; also by lack of scaliness, the disease not affecting the epidermis, as is the case with tinea versicolor. In chloasma the patches are brown, as they are in tinea versicolor; but unlike this disease and like vitiligo, the affection is in the corium, and the epidermis is unaffected; there is no scaliness in chloasma. The difference in locality is striking. Chloasma may be found in any part of the body, and is chiefly apt to occur in the face; tinea versicolor is never found in the face. The erythematous syphiloderm is sometimes confounded with tinea versicolor, but the history, and usually the distribution of the disease, with its lack of desquamation, will decide the diagnosis.

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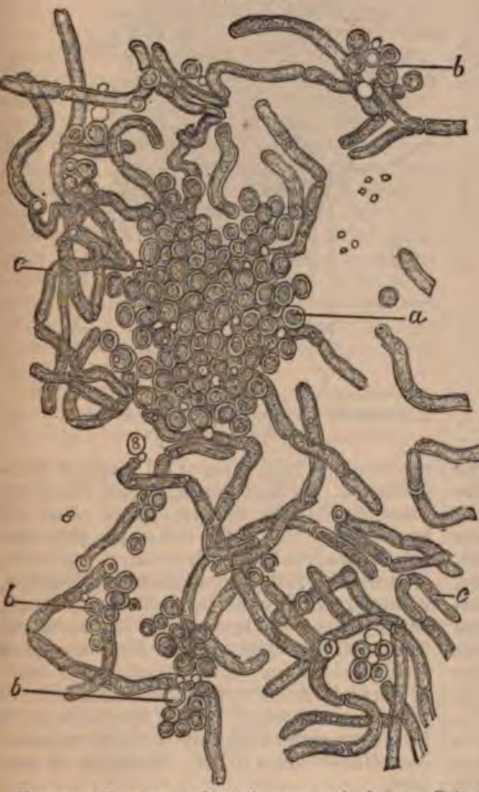
[1] See Duhring's Atlas of Skin Diseases, Plate G.

[1] The disease is one of several disorders formerly known by the absurd name of "liver spots," the truth being that the liver has no more to do with its production than it has with the occurrence of corns or bunions.

Fig. 943.



Fungus of tinea versicolor (microsporon furfur). *a.* Principal group of spores, forming a rounded mass. *b*, Small group of spores. *c*. Filaments of mycelium, formed of long, brilliant, and curved articulations. × 400 (Cornil and Ranvier).

The treatment of tinea versicolor is simple and satisfactory. A parasiticide of one kind or another, thoroughly applied, is all that is necessary. In dispensary practice, I find that the best plan is to have the patient rub sapo viridis into the affected skin nightly for seven nights, wearing the same underclothing continuously, and then, after twenty-four hours' interval, a hot bath with soap is employed, and the greater part of the disease is gone. This course of treatment must, however, be gone over again several times, to ensure a permanent cure. A more agreeable treatment is that by lotions of sulphite of sodium, a drachm to the ounce, the skin having been first cleansed by a hot bath with soap. Sulphurous acid, in full strength or diluted, may be used in some cases. Anderson recommends the following formula, to be rubbed into the affected parts night and morning:—

R. Hydrarg. chloridi corros., ℈j.
Saponis viridis, ℥ij.
Alcoholis, f℥iv.
Olei lavandulæ, fʒj. M.

Whatever treatment is employed must be thoroughly applied. If a single patch is left untouched the whole disease may return. Two or three weeks suffice for a cure, if the remedies have been well applied, but the patient should be inspected a little later, to see that the disease has not begun to crop out again in some obscure point.

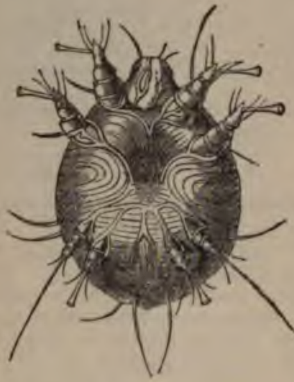
(2) ANIMAL PARASITIC AFFECTIONS.

SCABIES.

Scabies is a contagious, animal parasitic disease, due to the *sarcoptes scabiei*, characterized by the formation of cuniculi, papules, vesicles, and pustules, followed by excoriations, crusts, and general cutaneous inflammation, accompanied with itching. The female itch-mite no sooner finds itself on the skin than it begins its work of burrowing, forming within the skin a burrow or cuniculus, in which numerous eggs are laid, and which serves the itch-mite as a habitation during her life.

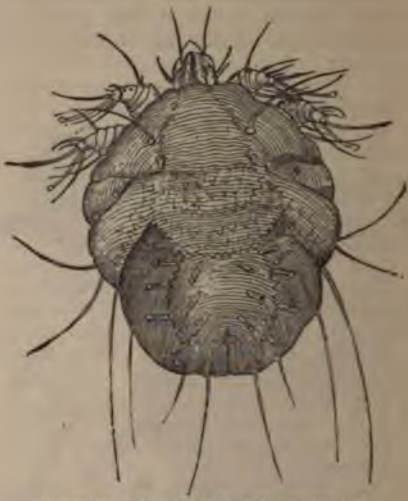
The male is said never to enter the skin, but to live upon the surface. After a time a certain number of young mites are hatched forth, all of which begin at once to care for themselves and to burrow. Thus the early symptoms of the disease are caused by the irritating presence of these parasites at various points, and characterized by the formation of minute, more or less inflammatory, puncta, papules, and vesicles. Later the cuniculi can be seen in the shape of more or less tortuous, beaded, yellowish or blackish lines, elevating the epidermis slightly, not thicker than a thread, and one-eighth to one-quarter of an inch in length. At a later stage scratch-marks, numerous papules, whole and torn vesicles and pustules, with crusts and blood crusts, show the results of irritation and scratching. The disease spreads day by day until a large area of the body may

Fig. 944.



Sarcoptes scabiei, male (McCall Anderson).

Fig. 945.



Sarcoptes scabiei, female; dorsal surface (Cornil and Ranvier).

be covered in neglected cases.[1] The form and multiplicity of the lesions are characteristic, as also are the regions of the body attacked. The affection, as has been said, usually begins about the hands, and especially the fingers. The wrists, penis, and mammæ are generally next invaded, followed by more or less eruption about all of the softer tissues of the trunk. The sides of the fingers and the folds where they join the hands are the particular localities attacked. The umbilicus, axillæ, and buttocks, in both sexes, are commonly invaded. The lower limbs are seldom involved to any great degree, except in cases of long duration. The toes, however, particularly in children, are often the seat of the affection.

Itching is a marked feature of the disease, beginning as soon as contagion has taken place, and increasing in severity with the extension of the disease. It differs in degree according to the susceptibility of the skin, as well as the temperament of the individual. It is constant, but is much worse at night, when the patient is warm in bed.

The cause of scabies lies in the irritating presence of the itch mite[2] in the skin. It is contagious, and may be conveyed by bedding or clothes, or even by a shake of the hand. Scabies is not a very common disease in this country. In Philadelphia, where the population is unusually cleanly, but twelve cases were observed in 2472 cases of all kinds of skin-diseases. In New York, where there are many foreigners, 62 cases were observed by Bulkley in 1617 cases of skin-diseases, observed in dispensary practice. Among the filthy populations of Europe, however, scabies is rife. In Vienna, where, perhaps, the dirtiest people in the world live, nearly 50 per cent. of Hebra's cases were scabies, and in Scotland 25 per cent. of McCall Anderson's skin-cases were of the same character. It is, therefore, seen how important a part the want of personal cleanliness bears in the causation of scabies.

The diagnosis of scabies is, as a rule, not difficult. The presence of the burrow or cuniculus is sufficient to decide the matter, and this should be looked for in every suspected case. The mite itself may usually be extracted with a pin from a recent vesicle or burrow, but failure to capture it, need not be regarded as negative evidence in the diagnosis, for it requires a good light, sharp eyes, and some dexterity to succeed. The burrows must not be confounded with irregular lines of epidermis filled with dust or dirt. The resemblance is, at first sight, strong. In the majority of cases, the burrows are to be detected only upon the sides of the fingers. The regions of the body mentioned above as the favorite seat of scabies must be taken into consideration in making up the diagnosis, and, finally, it must be remembered, that other affections may be intercurrent with scabies upon the body.

Once recognized, the disease is in most cases easily cured. The great point is to use the applications in such a manner, that the parasite may be destroyed without undue irritation of the skin, and indeed with relief to this condition. When the disease is recent, a cure can be rapidly and easily effected, but when of old standing, there is apt to be a good deal of eczema in connection with the scabies, and after the parasite is destroyed the eczema remains for treatment. Sulphur in one form or another is the best remedy. The skin is to be washed thoroughly with soft-soap and hot water, and if the disease is extensive, a hot bath should be taken. After this, the ordinary sulphur ointment may be carefully rubbed into the affected parts. It may be diluted to suit tender skins and infants. The inunctions should cease on the third day, and if the itching continues, soothing remedies may be applied until it is seen whether or no the insect has been destroyed. Too long persistence in the parasiticide may work injury after benefit.

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[1] The so-called army itch, prevalent during the late war, was nothing more than ordinary scabies neglected.

[2] For pictures and a full description of the itch mite, see Duhring's Treatise, p. 603.

Balsam of Peru, itself a parasiticide, may be advantageously joined to the sulphur in some cases, as follows :—

℞. Sulphuris sublimati,
Balsami Peruviani, āā ʒss.
Adipis, ℥j. M.
Ft. ungt.

Wilkinson's ointment, as modified by Hebra, is a preparation which may prove useful in not too tender skins where there is also some eczema. It is as follows :—

℞. Sulphuris sublimati,
Olei cadini, āā ʒij.
Cretæ preparatæ, ʒiiss.
Saponis viridis,
Adipis, āā ℥ij. M.
Ft. ungt.

McCall Anderson prefers styrax to sulphur as being clean, of a pleasant odor, and unirritating to the skin. This is his prescription :—

℞. Styracis liquidis, ℥j.
Adipis, ℥ij.
Liquefac. et cola.

The prognosis of scabies is always favorable. A week will suffice for a cure in average cases, but the irritation of the skin requires longer treatment to overcome.

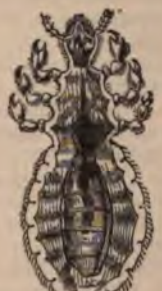
PEDICULOSIS.

Pediculosis is a contagious animal parasitic affection, characterized by the presence of pediculi and the lesions which they produce, together with scratch-marks and excoriations, accompanied with itching. Three varieties of the disease are encountered, which are designated according to the names of the species of pediculi or lice, viz., pediculus capitis, pediculus corporis, and pediculus pubis, or head, body, and crab lice.

PEDICULOSIS CAPITIS is due to the presence of the *pediculus capitis*, or head louse.[1] The parasite is found on the scalp alone, the occipital region being the favorite seat. The lice are sometimes found on the scalp, and sometimes on the hairs. The ova, small whitish pear-shaped bodies, glued to the hairs by the smaller end some distance from the scalp, resemble scales of epidermis. Pediculi capitis are usually met with in women and children of the poorer class, though they are sometimes found in persons of refinement. I have several times encountered them in ladies, when they appeared to have been contracted in sleeping-cars while travelling. The lice attack the scalp and give rise to considerable irritation, itching, and consequent scratching. Effusion of serum, pus, and blood results from this, and the hairs become matted together in a crust. The parasites as a rule cause more mischief in those who are badly nourished and ill-cared for. The majority of cases of eczema of the back of the head in the poorer class of children are caused by pediculi. When the affection has existed for some time, there is a disgusting odor about the scalp; the patient loses sleep from the itching; the mind becomes harrassed, and the general health may be more or less impaired.

PEDICULOSIS CORPORIS.—The parasite here is the *pediculus corporis*, or body louse, which should more properly be called the clothes louse, since it lives in

Fig. 946.



Pediculus corporis (female) (McCall Anderson).

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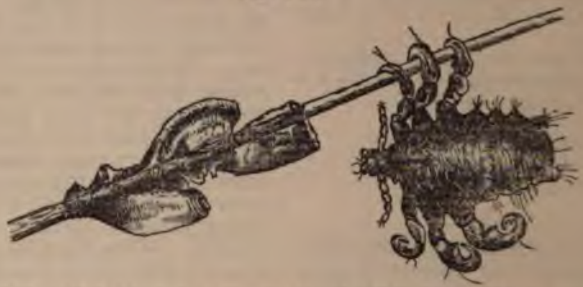
[1] For a picture of this pediculus, see Duhring's Treatise, p. 615.

the garments and thence makes predatory excursions upon the skin. It is very similar to the head louse in appearance, but is considerably larger. Body lice are apt to be found along the seams of the clothing, particularly where this comes in closest contact with the skin, as about the neck, shoulders, waist, and buttocks. As they move over the surface or attack the skin, they give rise to intensely disagreeable itching sensations. As the parasites multiply, the itching becomes so violent that the distress is almost unendurable; the scratching is generally severe; and long and streaked or short and jagged scratch-marks with blood-crusts and pigmentation are characteristic features of the disease. On close inspection, the primary lesions, which are minute reddish
slight areolæ, may be seen
points at which the parasit
blood.

The chief seats of the le
back, especially about the sca
the chest, abdomen, hips,
When the affection has laste
or years, general pigmenta
cur as the result of long con
tion and scratching. Child
seldom attacked.

Pediculosis pubis. — T
pubis, or crab louse, though
on the pubis, is also encour
axillæ, sternal region, and
male, eyebrows, and even eye
lice are found either crawlir

Fig. 947.



Pediculus pubis, or crab louse, with ova adhering to hair (Wilson).

hairs, or adhering closely to the surface of the skin; their strong claws permit them to take such hold of the hairs, that they are often detached only with difficulty. The ova are very much like those of the pediculus capitis, and are found firmly attached to the hairs.

They infest adults chiefly, and give rise to the same symptoms as the other pediculi. Although almost always contracted in sexual intercourse, yet they now and then find their way to the pubis of persons who are entirely unable to account for their presence; the amount of irritation caused by their presence varies with the individual—it is usually slight.

Pediculosis always occurs as the result of contagion; a spontaneous origin of the parasites is quite incredible. The pediculi do not bite, but are furnished with a sucking apparatus, which they insert into the mouth of a follicle, and obtain blood by means of this.

The diagnosis of pediculosis may almost always be made by finding the parasites, but these are frequently few in number in any given case, and must be carefully searched for, remembering in the case of each variety its especial habitat. When the pediculi cannot be found,
of the scratch-marks offers
cumstantial evidence pointing
sitic character of the disea
scalp and pubis the presence
almost always be made out,
course, are pathognomonic.

The treatment of pediculos
Perfect cleanliness must be
the first place, and in the cas
losis corporis and pubis all
should be boiled or baked
while the applications are be
the skin. The same may be
the head-coverings in pedicu
Beyond this the treatment of
varieties of pediculosis varies
each case. The best treatme
lice is to cut the hair short wh
and to saturate the scalp nigh
eral successive times with ke
being taken not to allow the
down over the face and neck f
causing excoriations. A night
used and the head washed wi
water in the morning. When ke
not be used, the next best thing
or tincture of cocculus Indicu
owing to shortness of hair an

ence of eczema, ointments are desirable; white precipitate ointment, in the strength of twenty to sixty grains to the ounce, will be found useful. An ointment, of one drachm of powdered stavesacre-seeds to the ounce of lard, is also a good remedy. The nits are to be removed by repeated washings with soda or borax washes, soft soap, vinegar, dilute acetic acid, or alcohol. It is seldom or never necessary to cut the hair. In children it is more convenient often to do so, but in adults it is an unnecessary sacrifice, which may be avoided by patience in relieving the hair of pediculi and nits.

Body-lice.—A hot bath, with soap, should be taken while the clothing is being heated in an oven, or boiled, to destroy the parasites with their ova. After the bath, inunctions are to be practised with an ointment of powdered stavesacre-seeds, two drachms to the ounce, digested in hot lard, and strained. Lotions of carbolic acid, as the following, will be of service in allaying the irritability of the skin:—

R. Acidi carbolici, f℥iij.
Glycerinæ, f℥j.
Aquæ, Oj.
M. Ft. lotio.

The process of disinfection of the clothing should be carefully carried out, and must be repeated again after a few days, if it has not been entirely successful.

Crab-lice may be removed by tincture of cocculus Indicus, of full strength or diluted, or by any of the ointments or lotions above mentioned. Ung. hydrarg., the popular remedy, is no more effectual than the others, and makes a nasty mess; its use is, in general, to be avoided in favor of the other applications.

The prognosis of pediculosis is always favorable, and when the directions are faithfully carried out a speedy cure may be expected.

ON PARASITES, AND THE DISEASES WHICH THEY PRODUCE.

BY G. BUSK, ESQ.

Revised by JOSEPH LEIDY, M.D.

UNDER the term "parasites" might properly be included all the organized beings which exist during a part or the whole of their life at the expense of other living animals or plants. In this sense an innumerable host of creatures would be included under the term, belonging to both the animal and vegetable kingdom. These have been divided into *true* and *false* parasites; and the former have even, by some writers, been erected into a distinct class, or rather into distinct classes, under the names of ento- and epizoa, or ento- and epiphyta; but, in a scientific point of view, it is obviously improper to maintain any such classification.

Parasitism is to be recognized more as an accident than as an essential attribute; and the mere circumstance that an organism lives at the expense of another living being affords no valid ground of distinction between it and others whose nutriment is derived from dead organic matter. It is, moreover, now universally admitted that all the so-termed entozoa, etc., belong to some one or other of the larger groups of non-parasitic forms already constituted in either kingdom. In the case, for instance, of parasitic animals, we find not only that they nearly all belong to the sub-kingdom Annulosa, but that they also fall into existing classes in it. The most that can be said of any among them is that they appear to constitute groups of ordinal value.

In any general account of the subject, therefore, parasites would have to be regarded in their relations to numerous closely allied forms; and the study, consequently, would be one of very great extent. It is one also, from many circumstances connected with their life-history, of extreme interest both to the naturalist and the physiologist. Here, however, we have to do almost exclusively with the surgeon; and the limits and objects of an essay like the present preclude both the possibility and the necessity of considering the subject in any such extent. We propose, in the brief space at our disposal, to give an account only of those parasites the consequences of whose invasion are likely to be brought under surgical treatment; and in doing this to enter only so far into their natural history as may be necessary for the suggestion of curative or prophylactic measures.

Classification of parasites.—In the first place they belong either to the animal or vegetable kingdom. We will commence with the former.

A. Animal Parasites.

Arranged in zoological order, these are found in the following classes:—

I. Infusoria.
II. Annuloida.
III. Arachnida.
IV. Insecta.

I. *Parasitic infusoria.* — Four or five minute organisms belonging to the heterogenous group of *infusoria* have been described as occurring in the human subject. They belong to the families Monadina and Holotricha. The former includes all infusorial animalcules presenting a simple and apparently homogeneous body, furnished at one end with one or more elonlongated vibratile filaments. The family, however, is a very doubtful one in its relations to the animal kingdom, and it is pretty certain that the majority, if not the whole of the monadina, merely represent the motile zoospores of various algæ or fungi. It is also extremely doubtful whether they should in any case be regarded as parasites, and not rather as merely the concomitants of putrefaction.

The supposed parasitic Monadina belong to the genera *Cercomonas* and *Trichomonas;* the former, characterized by the presence of a single vibratile filament, and the latter by that of two or more. The species of *Cercomonas* noted as parasitic are, *C. intestinalis*, *C. urinarius*, and *C. saltans.* The situations occupied by two of these forms are sufficiently indicated in their names, whilst the last is described as occurring in the discharge on the surface of foul sores; but its occurrence must be very rare, to judge from our own observations.

The only species (*T. vaginalis*) referred to the genus *Trichomonas*, presents points of rather more interest. Originally noticed by M. Donné[1] in the mucus of the vagina, he at first supposed it to be diagnostic of a gonorrhœal discharge, but subsequent observations by himself and others have shown that this is not the case. In fact, according to Kölliker and Scanzoni, it was found in the majority of the women examined by them, either pregnant or not. Its presence would appear, nevertheless, always to be accompanied by some morbid condition of the vaginal secretion, though that need not be exclusively of a specific nature. It is to be remarked, moreover, that its habitat is exclusively the vagina, as it is never found even in the cervix uteri. The animalcules vary in length from $0^{m}.008$ to $0^{m}.018$, and they are usually furnished, in addition to the whip-like appendages, with a few cilia at their base. In their natural nidus they exhibit active movements, which, however, soon cease on the addition of water, in which they swell up into a spherical form, and assume very much the appearance of ciliated epithelium cells, for which they have sometimes been mistaken.

In the family Holotricha, among the true ciliate infusoria, the only parasitic form observed, if it really deserve the name, is a species of *Paramœcium* described by Malmsten as occurring in the cæcum and colon.

II. *Parasitic Annuloida.*—Dividing the Annulosa into three primary groups or provinces, viz., the Arthopoda, Annulata, and Annuloida, we shall find that all the more important parasites belong to the first and last, which alone includes almost all the true entozoa. In the arthropoda, the classes arachnida and insecta both afford instances of occasionally or permanently parasitic species; whilst in the annuloida, or most lowly organized division, in which we include the scolecida, gephyrea, echinodermata, and rotifera, they are found only among the first. The orders included in this class are:—

1. Tæniada	Platyelmia.
2. Trematoda	
3. Turbellaria	
4. Acanthocephala	Nematelmia.
5. Nematoidea	
6. Gordiacea	

With the exception perhaps of the Turbellaria, all these orders may be regarded as composed of parasitic creatures.

(*a*) *Platyelmia or flat worms.*—The members of this sub-class are characterized by a more or less flattened body, usually very short, but in some cases, as among the Turbellaria, of considerable length. They are generally furnished with external appendages for the purpose of motion or of attachment, and consisting in some cases of suctorial discs or acetabula, in others of hooks of various kinds, or of both combined. Most of them are hermaphrodite, and in many the course of development presents strange and peculiar phenomena. With respect to their organization, it may be stated generally that the platyelmia have no proper visceral cavity, the body being composed, as it were, of a solid parenchyma, in which the viscera and muscular tissue are closely imbedded. On this account some among them have been termed sterelmintha. Considerable diversity exists in their alimentary system; for while some have a complete canal with oral and anal orifices, and a protusile pharynx, in others the anus is wanting, and the mouth a mere pore, and in some, which are endoparasites throughout their existence or nearly so, no trace of mouth or alimentary canal exists; the nutrition of the worm being carried on through the external surface. None possess any true blood-vascular system; but in all there is a distinct system of so-termed "water-vessels," probably of a renal or excretory nature; and which in some pervades the entire body with its fine reticulations, in the ultimate extremities of which are lodged minute calcareous or phosphatic particles. The nervous system is either wholly inapparent or very rudimentary.

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[1] Récherches Microscopiques; Sur la nature du mucus, 1837, and Cours de microscopie, 1847, pp. 157–161; fig. 33.

Tæniada,—Tape-worms.—In this order, which has sometimes received the name of Cestoidea or Cestoda, are included also the so-termed Cystica or cyst-worms, the reason for which will be apparent from what follows. In addition to the characters they possess in common with all the platyelmia, the Tæniada may be distinguished by the following. They have neither mouth nor intestine; and in the mature or sexual condition are united into a continuous band or chain, originating in an individual or zooid, which itself never reaches sexual maturity, but continues to throw off a succession of buds or gemmæ, each of which becomes a perfect hermaphrodite individual, though remaining attached to the colony, of which it forms a link, for a considerable length of time. The separate zooids constituting this compound growth of *strobila* become more and more developed as their distance from the primary joint increases, until, having reached full maturity, they are successively detached, either spontaneously or accidentally, and pass out of the body with the feces. The primary zooid remains all the time attached to the intestinal mucous membrane of the host by one or other of the organs mentioned above. This individual is termed a *scolex*, and each separate joint or sexual zooid budded from it a *proglottis*. This is the condition of the entozoon when it forms what is termed a *Tænia*, or tape-worm, which consequently must be taken to represent a chain or continuous succession [illegible] rriving at [illegible] n off. In [illegible] thin the [illegible] lishes, in [illegible] ndition, [illegible] ri- [illegible] es of the body external to the intestinal tract; but here they exhibit a totally different aspect, constituting, in fact, the so-termed *cystica*, or cyst-worms. It is also a remarkable circumstance that, so far as is known, with the exception of the human subject, the tænioid and the cystic states of the same species are never found in the same animal. The cyst-worms of one animal give rise to tape-worms in another, and *vice versâ*; and what is equally remarkable is the fact that these are in almost all cases reciprocally herbivorous and carnivorous or omnivorous species. As, for instance, the cyst-worm of the sheep or rabbit will produce tape-worms in the dog and cat; those of the pig and ox become tape-worms in man, etc. This curious state of things arises in the following way: The mature proglottis of tænia is filled with ova, each of which, within a firm and peculiarly resistant shell, contains a minute active embryo, which from its being armed with six hook-like boring instruments, has been termed a "six-hooked embryo," or "hexacanthus." For the exclusion of this embryo, it appears, from repeated observations and experiments, to be necessary that the ovum should be subjected to the solvent action of the gastric juice in the stomach, usually of another species of animal than that in which the proglottis was nurtured. But when thus liberated from its durance the "hexacanthus" speedily makes its way through the walls of the intestine of its new host, and effects a lodgment in the tissues of the body, after a migration of greater or less extent. Having reached its ultimate destination, the hooks are thrown off, and the embryo is transformed into a cyst-worm, which differs according to the species of tape-worm from which it originated. This is the general mode of proceeding in the tæniada; and it will consequently be seen how the cystica, which were formerly regarded as a distinct class, are nothing more than one phase in the life-cycle of tæniada. The only apparent exception, as yet observed, to the rule, that for the exclusion of the active embryo the ovum containing it must pass through the stomach of an animal, is that of *Bothriocephalus latus*, in which it would appear that the embryos are capable of living in water, after escaping from the ovum, in the form of a ciliated infusorium or planula; and it is a curious circumstance that in this species the egg-shell is furnished with a sort of movable lid, to facilitate the escape of the embryo.

The various forms of cyst-worms have received the generic names of *Cysticercus*, *Cœnuris*, *Echinococcus*, and *Anthocephalus*; and it is with the tæniada in this phase only that we have here much concern, the tape-worms themselves coming more properly under the notice of the physician.

The following species of tæniada are enumerated by Dr. Cobbold[1] as having been met with in the human subject; some are perhaps apocryphal. Opposite the name of each tape-worm or "strobila" we have given (when known) that of its cystic representative.

1.	Tænia solium	Cysticercus cellulosæ.
2.	" mediocanellata	" t. medio-canellatæ.
3.	" acanthotrias	
4.	" flavopuncta	
5.	" marginata	" tenuicollis.
6.	" echinococcus	Echinococcus, Acephalocyst, etc.
7.	" nana (Siebold)	
8.	" elliptica	
9.	Bothriocephalus latus	
10.	" cordatus	

1. The cystic scolex of the common tape-worm is the *Cysticercus cellulosæ* of authors. The most usual habitat of this species is the muscular tissue of the pig, which when thus affected is said to be "measly." It is frequently met with, however, in other situations and in other animals, especially in man. It is distinguished by its quadrangular head, short neck, thickened anteriorly, its long cylindrical body, and elliptical caudal vesicle, which, when the worm is lodged in the muscles, has its long diameter in the direction of the fibres. Nothing very positive is known respecting the earliest stages of the development of the "six-hooked embryo," as it does not appear by any means quite certain that the peculiar elongated cysts in muscle first noticed by H ssling, and afterwards more fully described by Mr. Rainey,[2] have any actual relation to this *Cysticercus*.

In the earliest stage at which it has been positively made out, the worm is about 1 millimetre in length, and nearly spherical in shape. It is formed at this time simply of a minute vesicle, whose walls exhibit a distinct and rich plexus of vessels, within the smaller branches of which vibratile tags are visible, whilst the interior of the vesicle is filled with a clear fluid. On one part of the wall the rudiment of the head or future scolex may be seen as a small opaque spot. The development of this part gradually proceeds, until at length it attains its full size, and projects into the interior of the enlarged cyst, invaginated, as it were, in a sac formed from the internal layer of the cyst. At first the "head" is straight; but as it increases in size it becomes bent at nearly a right angle, and eventually at its lower or inner extremity the characteristic acetabula and hooks of the tænia make their appearance. The entire course of development up to the completion of the cysticercal condition appears to require between two and three months. How long the parasite may remain in this stage within the tissues of its host is unknown, though it would appear from the observations of Stich[1] not to exceed a few years at most.

Though comparatively rare among ourselves, it seems that in some countries the occurrence of *Cysticercus cellulosæ* as a human parasite is by no means uncommon. This difference it is not easy to account for, unless, with Leuckart, we admit the possibility of self-infection from the ova of the tape-worm, and consequently that a difference in habits of cleanliness or care may be followed by corresponding consequences. It is not improbable, however, that a greater frequency of occurrence of *Cysticerci* in the pig in any country will lead to a greater frequency of occurrence of the tape-worm in man; and the more especially so, when, as is the case in many parts of Germany, large quantities of pig's-flesh in an almost uncooked or raw state are consumed. As a proof of the frequency of *Cysticercus cellulosæ* in certain districts, we may mention that Rudolphi states that in his experience it was met with in about one body in fifty-six of those brought into the dissecting-room at Berlin; and it would seem that in many parts of Germany scarcely a year passes in any anatomical school without instances of its occurrence. These instances, however, have for the most part only been discovered after death; the presence of the parasite when lodged in the muscular tissue being, except in rare cases, apparently unattended with any symptoms.

The comparative frequency of *Cysticercus* in the different organs or tissues may be stated in the following order:—

The muscular tissue, or rather perhaps the inter-muscular connective-tissue; the brain and eye; heart; lungs; liver; and, more rarely, the kidney and lymphatic glands. The spleen, and even the osseous tissue, according to Stich, are not exempt from its invasion; though with respect to the latter situation at any rate considerable doubts of its occurrence may reasonably be entertained. It may be observed, also, that in cases where *Cysticerci* are found in the muscular tissues, they usually exist in vast numbers; whilst in cases where they occupy other situations, they are usually few in number, or even solitary. As regards the human subject it has been suggested by Leuckart[1] that where the parasite has been found in considerable numbers, it has been in cases of what may be termed self-infection conveyed by the passage of a tape-worm or of a proglottis, or it may be of some ova alone into the stomach. The not infrequent occurrence of *Cysticerci* in the tissues with tape-worms in the intestine affords, as he remarks, a strong proof of this. Von Gräfe relates that of thirteen individuals treated by him for *Cysticerci* in the eye, five were also infested with tape-worm. The fact, at any rate, points to the necessity of care, in persons so affected, not to infect themselves with the mature ova either externally or internally. For it is not improbable that the "hexacanthus" may be liberated from the ovum by mechanical violence as well as by the solvent action of the gastric juice; and when thus liberated, it may be capable of making its way as easily through the membranes of the eyeball as of the intestine.

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[1] Proceed. Zool. Society, 1862, p. 289.

[2] Phil. Trans., 1857, p. 111.

[1] Annal. d. Charité Krankenhauses, 1854, p. 170.

With respect to the symptoms produced by *Cysticercus cellulosæ*, it has been already said that when confined, as is most usual, to the muscular or subcutaneous connective tissues, the parasite appears to be wholly innocuous. The power even of the affected muscles is not notably impaired; and this is the case, it would seem, with the heart as elsewhere. Nor do the adventitious cysts in which the worm is lodged seem to be liable to spontaneous inflammation, though instances are recorded of their becoming inflamed and suppurating in consequence of pressure or external injury in exposed situations; as on the extremities, nates, etc.

It is far otherwise, however, when the entozoon has penetrated into the eye or brain. Passing over, here, the symptoms arising from its presence in the latter situation, we will refer more particularly to the morbid phenomena produced by it in the organ of vision. For our knowledge of this subject we are chiefly indebted to Professor von Gräfe, who seems to have enjoyed abundant opportunities of studying it. His papers will be found principally in the Archiv für Ophthalmologie for 1857. In the eye the *Cysticercus* presents itself in two different conditions, free and encysted. The former occurs only in the aqueous chamber, or in the crystalline body, or rather in its capsule; and it is considered probable that these free embryos have escaped into those situations from cysts originally lodged in the coats, and especially in the iris or choroid. Occasionally, however, when in the crystalline lens, the vermicule becomes surrounded with a secondary cyst. The changes and injurious effects produced vary, of course, according to the situation occupied by the *Cysticercus*. In the subconjunctival connective-tissue its presence is rarely manifested by any symptom beyond occasional slight conjunctivitis. But when lodged in the aqueous chamber the consequences are more important; for not only does it directly hinder the free passage of the rays of light, but the irritation caused by it is often accompanied with a chronic inflammation of the surrounding membranes. And its effects when in the deeper parts of the organ are still more serious. Here it may be lodged, enclosed in a capsule, either beneath the retina or in the vitreous humor. It is probable that it always makes its way through the retina to reach the latter situation. The presence of the parasite on or near the retina and choroid induces chronic inflammation and disorganization of those important parts, eventually leading even to total blindness.

The objective signs of the presence of a cysticercus in the eye are extremely obscure without the aid of the ophthalmoscope. But with the aid of that instrument the parasite may be detected in the bottom of the globe, where it appears in the form of a light-colored or semitransparent vascular swelling, whose position with relation to the retina may, in some cases, be determined by the appearance of the capillary vessels. When the cyst is covered in front by the retina, the vessels of that coat will be seen coursing over the little swelling; but when it is lodged in the vitreous humor or on the inner surface of the retina, the vessels, it is said, will be seen to terminate suddenly as they pass behind the tumor. The prognosis, in most cases, will be more favorable in the latter case than in the former.

2. *T. echinococcus.*—Another and far more familiar tænioid entozoon is that of which the *Acephalocyst* and *Echinococcus* represent the cystic and scolecid conditions. The tænia or strobila of this species is at present known to occur only in the dog and wolf. It is of small size, and usually exists to the number of many thousands among the villi of the small in-

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[1] Mensch. Parasit., p. 281.

testine, where the tæniæ are rendered apparent by the white color of the mature proglottides.

The ordinary form in which this entozoon occurs in the human subject is that of a semitransparent globose vesicle, with highly-elastic laminated walls, lined with a finely-granular layer, and which is lodged, sometimes in great numbers together, in the parenchyma of the liver, lungs, or other solid viscera, or in the connective tissue in almost any part of the body, usually enclosed in a distinct capsule formed by exudation into and the consolidation of the surrounding tissue. The interior of these cysts is filled with a clear watery fluid, in which may sometimes, but by no means always, be seen floating a few or many tænia-heads, or scolices, the so-termed *Echinococci*. Sometimes, however, the only remains of these will be the minute hooklets with which they are armed. But though usually met with in this detached condition, these heads in the recent and perfect state of the cyst will be found adherent to its inner wall, or granular layer, to which they appear to be attached by a short peduncle. When so attached, they are seen through the transparent walls of the acephalocyst as minute opaque or whitish specks. It more often happens, however, and as it would seem especially in the human subject, that numerous acephalocysts may be examined without the discovery of a single echinococcus-head.

Hydatid cysts are capable of multiplying themselves in other ways; and it is to this property that their destructive power is mainly due. Although an individual cyst may singly attain to enormous dimensions, it is more from their rapid and continued propagation that the large hydatid tumors, and consequent great mischief caused by them, are produced. This multiplication takes place by what may be termed a sort of gemmation or proliferation in the walls of the cyst; and it is effected in two or three different ways. (1.) The secondary cysts arise in the substance of the walls of the parent hydatid; and when they have reached a certain size become detached, and are then capable of independent growth, and of again themselves throwing off similar buds; and so on *ad infinitum*. (2.) The secondary cysts may be protruded and thrown off either on the exterior or into the interior of the parent vesicle. In the former case we have the exogenous form of hydatid, or the *E. scolecipariens* of Küchenmeister; and in the latter is produced the well-known endogenous or "pill-box" hydatid of authors. Both forms occur in the human subject, though the latter by far the more frequently; and they may both even be found in the same subject. In either case the multiplication is sometimes carried to an enormous extent, and yet in the whole number of hydatids not a single Echinococcus will be found. Professor Leuckart mentions a case of a woman about sixty years of age who had a tumor for many years, which was supposed to arise from an extra-uterine fœtation, but on examination after death was found to be caused by a colossal acephalocyst springing originally from the liver, but which had gradually filled the abdomen with a sac weighing with its contents about thirty pounds. In its interior were many thousands of secondary cysts, from the size of a pea to that of the fist; but not a single "head" or hooklet was anywhere discernible.

Acephalocysts with several hundreds of secondary cysts are not uncommon; but usually the number of the latter is under a hundred, and generally perhaps from twenty-five to fifty.

(3.) A third modification in the mode of development, or rather of multiplication of hydatids, has been described under the name of *E. multilocularis*. In this form the cysts never attain to anything like the dimensions of the two former, rarely exceeding those of a millet-seed, or at most of a pea. But though of these small dimensions, the cyst is capable of producing compound growths of considable size, consisting of aggregations of vesicles imbedded in a common stroma. When a mass of this kind is cut across, it presents in the interior innumerable minute cavities of irregular form, separated by condensed connective-tissue, and containing a tolerably transparent gelatinous material. Running amongst them may be seen the atrophied remains of the bile-ducts or bloodvessels, etc. Growths of this kind have hitherto been observed only in the liver; but as there appears to be no reason why they should not occur elsewhere, it may be useful to advert a little further to them. The alveolar structure and the gelatiniform nature of the contents of the cysts naturally led observers at first to suppose that they constituted a form of colloid cancer, the occasional presence of echinococcus-heads or hooklets being deemed a merely accidental complication. Virchow,[1] however, has clearly pointed out the correspondence between the so-termed colloid masses and minute echinococcus-cysts. His observations have since been amply confirmed by Professor Leuckart,[2] who has fully satisfied himself that all the cysts, down to the smallest, present the well-known characters of the common acephalocyst.

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[1] *Das alveolar Colloid der Leber*, Tübingen, 1854.

[2] Op. cit., p. 373.

He, moreover, ascertained that the echinococcus-heads contained in them were identical with those found in the usual hydatids, and that the multiplication of the cysts followed the type of *E. altricipariens.*

The connection between the hydatid cysts and the tænia, from which they are derived, hardly requires to be here pointed out, after what has been said on the general mode of development of the tæniada. The strobila in the intestine of the dog throws off proglottides containing the mature ova, which, on passing into the stomach of another animal, liberate the enclosed embryos, which make their way though the walls of the intestine, penetrating either directly into the contiguous connective-tissue, or into the bloodvessels, by which they may be conveyed through the branches of the portal system into the liver, or through other channels into all parts of the body. Hydatids consequently, even to a far greater extent than *Cysticerci*, may be found in any part and in any of the tissues, including the bones themselves. In some respects, however, the two forms of cystic worms seem to affect different tissues by preference. The most common seat of the *Cysticercus* is, as has been said, the muscular system—a situation in which acephalocysts rarely occur. The eye and brain, also, are more rarely invaded by acephalocysts than by *Cysticerci*. By far the most common situation for hydatids in the human subject is the liver. In other situations, out of nearly 200 cases, Professor Leuckart states that in about 40 the lungs were the seat of invasion; in 30, the muscular and subcutaneous connective-tissue; in 30, the kidneys; in 26, the lower pelvis; in 20, the nervous centres; in 17, the bones; and in 10, the heart. In the remaining 17 the parts invaded were the orbit, eyeball, mouth, thyroid body, walls of uterus, etc. In general, in man, hydatids are confined to a single locality, though this is by no means always the case.

The frequency of occurrence of hydatids appears to vary much in different parts of the world. [In the United States they are very rare.—P.] In this country, and in Europe generally, they are but rarely met with; whilst in Iceland it would seem that one-fifth or one-sixth of the entire population suffers from their invasion. In any case the poor appear to be more often affected than the rich—a circumstance easily explicable by their different habits.

The growth of hydatid tumors, when, from their external situation or from other circumstances, their existence is early manifested, appears to be extremely slow. Thus Velpeau removed a hydatid tumor from the axilla, which in six months had only reached the size of a walnut; and, in another case, the tumor had attained the size of the fist in about a twelvemonth. The endogenous or "pill-box" hydatid is probably slower of growth than the other varieties, although in process of time it may acquire far greater dimensions. The ill effects of a hydatid growth vary, of course, according to its site. The more important situations in which tumors of this kind present themselves to the surgeon's notice are in the liver, eye, bones, and in external situations in any part of the body. A not unfrequent situation, also, is the lower pelvis, where by its growth the tumor may so far impede the functions of the bladder, uterus, or rectum, as to call for operative interference. The diagnosis, however, of such cases is extremely difficult, as similar symptoms may, as is obvious, arise from tumors of almost any kind in the same situation. The distinction, perhaps, might be drawn more from collateral circumstances or negative proofs than from any positive symptoms. When developed in the interior of a bone, the signs of a hydatid growth would be equally obscure until the tumor had reached considerable dimensions, or an exploratory opening had perhaps been made.

When it occurs in the eye, the effects of an acephalocyst would be much the same as those produced by a *Cysticercus*, except that as the growth of the latter is far more rapid, the ill consequences of the parasite are slower of development in the one case than in the other. The distinction during life, however, would be extremely difficult, and of no practical importance.

Although the duration of hydatid tumors is generally very prolonged, in fact lasting for the whole of life, it not unfrequently happens that they die, as it were, at an early period, and either cause suppuration, and are thus discharged, or become cretified and wholly innocuous.

The best treatment of a hydatid tumor appears to be that of making a free opening into it, so as to give exit to the contents and a vent to any subsequent discharge. In cases of hydatid tumor of the liver, it has been proposed, and the proposal has been occasionally carried out with success, to make the incision at two intervals in cases where there was reason to suppose that no adhesion existed between the wall of the abdomen and the coverings of the cyst. But in the majority of cases it will, perhaps, be better to wait until there is fair reason to conclude that adhesion has been set up. The injection of the cysts with various solutions, as of iodine, perchloride of iron, nitrate of silver, etc., has been practised; and some have thought with good effect. As the wall of the cavity containing the acephalocysts is in some respects analogous to those of a chronic abscess, the closure of the cavity when emptied will take place in the same way as in the case of an abscess.

None of the other species of Tæniada infesting man require any observation here.

Trematoda.—The Trematoda, in many respects allied to the Tæniada, differ from them in the possession of a distinct alimentary canal, with a mouth, but without any anal opening. They are always solitary, and never associated into compound growths. They are for the most part hermaphrodite, though in some cases the sexes appear to be distinct. As in the Tæniada, the vitellus is furnished by a distinct vitellarium. In the course of their development, the Trematoda, like the Tæniada, present several phases, and require for its completion to migrate from one animal to another. Unlike the Tæniada, however, with the probable exception of *Bothriocephalus*, the larval forms of the Trematoda are enabled to live, probably for a long time, and to enjoy active powers of locomotion, external to the body of an animal, into which also they are capable, in many cases, of making their way through the integuments. They thus form, as it were, a link between the parasitic and non-parasitic scolecids, having relations on one side with the Turbellaria, and on the other with the Tæniada. The course of development of a trematode may be thus briefly described: from the ovum, generated in the mature fluke, is produced a ciliated embryo or planula, which, after remaining in the water for some time, is converted into an elongated vermiform creature, sometimes termed a "redia," which in some cases possesses a tolerably well-developed alimentary tube and a distinct opening for the exclusion of the young; whilst in others it is reduced to a simple elongated tube, with no visible trace of internal organization, and immobile. Within these rediæ or cercaria-sacs are produced, by a sort of internal gemmation, numerous minute tadpole-like creatures (*Cercariæ*), which, when liberated, swim actively about until they meet with a suitable "host," into which they bore their way, casting off the now useless caudal appendage.

Although some such cycle as this has been clearly traced in several species of Trematoda, nothing of the kind has as yet been ascertained with respect to those infesting the human frame. It is only from analogy that these have been supposed to undergo similar changes. Whether the sheep, in which the liver-fluke is so extremely frequent, become infected by swallowing with the grass they feed upon snails into which the cercariform larvæ of a Distoma had entered, or whether they receive the Cercariæ in the water they drink, as is perhaps more likely, has not as yet been made out. Nor is there anything further known as to the mode in which flukes enter the human body.

About nine species of trematode entozoa are recorded as occurring in the human subject:[1]—

1. Fasciola hepatica, Linn. (Distoma hepaticum, Aut.)
2. Distoma lanceolatum, Mehlis.
3. " crassum, Busk.
4. " opthalmobium, Diesing.
5. " heterophyes, Von Siebold.
6. Bilharzia hæmatobia, Cobbold.
7. Tetrastoma renale, Delle Chiaje.
8. Hexathyridium pinguicola, Treutler.
9. " venarum, Treutler.

Fortunately, however, most of this formidable list are of very rare occurrence, and the majority have been met with only once or twice. One or two only among them offer any points of interest to the surgeon.

(1.) *Fasciola hepatica.*—The common liver-fluke of the sheep has been met with in the human body less rarely perhaps than any of the rest; but even of its occurrence not more than nine or ten cases are recorded. It was found in the gall-bladder by Mr. Partridge; and in the liver itself, or more probably in the biliary ducts, by Bidloo, Wepfer, Pallas, Brera, and Mehlis; in the duodenum, by Brera; and several together in the portal vein and its branches, by M. Duval. Three apparently well-proved cases of the occurrence of the liver-fluke in subcutaneous abscesses have been recorded. In one instance, related by Giesker and Frey,[2] the abscess was in the sole of the foot; in another, related by ourselves,[3] a living *Fasciola* was extracted by Mr. Charles Fox, of Topsham in Devonshire, from an abscess behind the right ear. A third case is reported by M. Dionis des Carrières,[4] in which the fluke was extracted from a tumor in the right hypochondrium. The swelling was about the size of a pigeon's-egg, and excessively painful, hard, and at first deep-seated. A fourth instance of the same kind, but perhaps not so thoroughly authenticated in all respects, though we ourselves see no reason to doubt it, was communicated to Prof.

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[1] Dr. Cobbold, Proc. Zool. Soc., 1862.

[2] Mittheilungen der Naturforschender Gesellschaft in Zürich, 1850, ii., p. 89.

[3] Küchenmeister, Manual of Parasites (Sydenham Society's translation), vol. i., Appendix, p. 434.

[4] Davaine, Traité des Entozoaires, p. 320.

Owen by Dr. J. Penn Harris, of Liverpool.[1] In this instance several flukes were said to have been found in an abscess under the scalp. One peculiarity in all these cases consists in the tendency the abscesses showed, after they had been opened, to close and become refilled.

(2.) *Distoma ophthalmobium*, Diesing (*Monostoma lentis*, Nordmann). In the eyes of several species of fish a peculiar trematode parasite, termed *Diplostomum volvens*, was discovered by Von Nordmann, and has been excellently described and figured by him.[2] Prof. Jüngken[3] extracted a lens in a state of incipient cataract, in which he found eight minute trematoda, which were referred by Von Nordmann to the genus *Monostomum*. And Gescheidt[4] found in the eyes of a child five months old, affected with congenital cataract, between the lens and its capsule, four specimens of a *Distoma* ¼ to ½ a line in length, some of which exhibited signs of vitality thirty-six hours after the death of the child. Dr. Cobbold considers that "all these circumstances render it probable that the worms extracted by Prof. Jüngken were specifically identical with those removed by Gescheidt."

What relation these trematoda have to that of the fishes' eye, or what their origin and life-history may be, is at present wholly unknown.

(3.) *Bilharzia hæmatobia.*—This minute filiform species, which is not more than three or four lines in length, is distinguished among its congeners by its being bisexual. It appears to be extraordinarily abundant in Egypt, having been noticed by Griesinger 117 times in 363 bodies. Its primary habitat seems to be in the portal-venous system, and it is especially common in the minute veins in the walls of the urinary bladder. Its presence in the latter situation is indicated after death by circumscribed patches of inflamed and thickened mucous membrane, and by tenacious viscous grayish-yellow exudations, in which the ova of the entozoa are lodged. The ova are also sometimes found free in the urine, and thus afford a ready means of diagnosis. The vascular spots are sometimes raised into pedunculate excrescences one to three lines high, and having a fungous or verrucose appearance. The inroads of the worm are, however, not always limited to the bladder, but may extend to the ureters, or even as far as the pelvis of the kidney itself. When the ureters are affected, the thickening of the submucous tissue may produce such a constriction of the canal as to cause retention of urine above it, and thus to lead to dilatation of the pelvis, and ultimately to disorganization of the gland. The aggregations of ova not unfrequently also constitute the nuclei of calculous deposits; and this appears to be the nature of the lithiasis of the Egyptians, described by Prosper Alpinus.[1]

It is proper here to notice a peculiar cutaneous affection, occasionally very prevalent amongst British troops in India, and more especially at Delhi, whence the affection in question has been named the "Delhi-boil," though not in reality having any furuncular character whatever. It is not, however, confined to that city, having been observed in many other and widely remote localities, as in Scinde, and at Lahore, Agra, Meerut, Roorkee, Mooltan, and elsewhere.

Though well known, and often discussed, the true nature of this affection has hitherto never been satisfactorily explained. But in the Report of the Army Medical Department for 1868 (pp. 319–321) are two papers, by Staff-Assistant-Surgeon J. Fleming and Staff-Surgeon-Major A. Smith, whose observations strongly tend to show that the "Delhi-boil" is caused by the invasion, probably, as suggested by Mr. Smith, through the sudoriparous pores, of a parasitic organism; and it would seem by no means improbable that this may be referred to some species of *Distoma* or other Trematode, in the cercariform or embryonic condition. Furthermore, it appears to be pretty conclusively shown that the parasite is conveyed through the medium of the well or tank water used for the purposes of ablution. A remarkable circumstance corroborative of which is cited by Mr. Smith, in the fact "that scarcely a single dog belonging to the military which may have been for any length of time in Delhi, escapes contracting the disease on the tip of the nose." The affection, as described by Assistant-Surgeon Fleming, is a morbid growth affecting the skin and subcutaneous tissue, which after a time ulcerates, but is unattended, until ulceration has commenced, with any inflammation. It commences very like a mosquito-bite, the little red spot increasing slowly in size, with a well-defined border, and raised above the surrounding skin. The growth continues to spread for two or three weeks or more, and as it progresses it becomes more elevated and covered with tortuous dilated vessels. A vesicle at length forms at the summit, which discharges a pale yellowish serous fluid. Ulceration then commences, and proceeds centrifugally until the whole growth is destroyed. The ulceration sometimes even extends to the neighboring structures, and if the ulcer is situated near the eyes, nose, or lips, those parts will almost be sure to be destroyed or materially injured, not excepting the cartilages of the nose. During the growth of the tumor it has a transparent and shining aspect, and if examined with a lens exhibits one or more yellowish spots, deeply seated about the centre of the tumor. If one of these spots be cut down upon with the dissecting needle, a small circular yellowish body with a glistening capsule may be easily removed.

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[1] Küchenmeister, op. cit., Appendix, p. 435.

[2] Mikrographische Beiträge, p. 28, pl. i., figs. 1–3.

[3] Küchenmeister, Manual, vol. i., p. 245.

[4] Von Ammon, Zeitsch. f. Ophthalmol., iii., No. 4.

[1] Küchenmeister, loc. cit., vol. i., p. 285.

Dr. A. Smith describes the affection rather differently, but there is no difficulty in reconciling his description with that above given.

From the description and figures contained in these two interesting reports, it is impossible to come to any positive determination respecting the true nature of the supposed organisms found in the "boils," but the subject is one well deserving investigation; for should the views of Surgeons Fleming and Smith be confirmed, there could be no difficulty in the devising of such prophylactic measures as should entirely, or almost entirely, prevent the occurrence amongst our troops of this troublesome, and, as it would seem, sometimes serious malady.

(*b*) *Nematelmia.*—The nematelmia, or round worms, although, from certain points in their organization, more particularly with respect to the circulatory and nervous systems, very distinct from the annelida proper, nevertheless approach that class far nearer than do the platyelmia, than which they are much more highly organized. The body, which is always elongated and cylindrical, does not consist of a solid parenchyma with the viscera simply embedded in it, but contains within a distinct integument a true perivisceral cavity, in which the alimentary and reproductive organs float freely. Within the integument also, and closely attached to it, are usually longitudinal muscular bands, which enable the animal to perform various and active movements. In most of the nematelmia also the alimentary and reproductive systems exhibit a considerable advance. The former consists in all cases of a distinct tube, usually subdivided into a pharynx or œsophagus, stomach, and intestines, and in most furnished with a mouth and anus, though in some few instances, as in the Gordiacea, the latter may be wanting. The mouth is sometimes armed with hooks, or other horny parts; sometimes quite simple. As regards the reproductive system, the sexes are always distinct, although the male and female organs are for the most part formed on the same common type. In both sexes the reproductive organ is represented by a long slender tube, in which, in the female, may be distinguished an ovary, Fallopian tube, uterus, vagina, and vulva; corresponding to which in the male we find a testicular portion, a vas deferens, a sort of vesicula seminalis, and an ejaculatory portion or duct, and in many cases an intromittent organ or penis. In the male the genital tube appears invariably to open at the hinder extremity of the body; whilst in the female the vulva may be in almost any part, and is very often to be found about the middle of its length. Impregnation is internal, and many species are viviparous. In one case only (*Trichina*) does anything like migration from one animal to another appear to be necessary for the development of the species. In some instances the male and female are alike in size and form; but in most they differ considerably in both respects, the male being sometimes immeasurably smaller than the female.

Numerous entozoa belonging to this sub-class have been mentioned as occurring in the human subject, of which the following is a list:—

1. Ascaris lumbricoides, Linæus.
2. " mystax, Rudolphi.
3. Trichocephalus dispar, Rudolphi.
4. Trichina spiralis, Owen.
5. Filaria medinensis, Gmelin.
6. " lentis, Diesing.
7. " bronchialis, Rudolphi.
8. Strongylus gigas, Diesing.
9. Sclerostoma duodenale, Von Siebold.
10. Oxyuris vermicularis, Bremser.

?11. Spiroptera hominis, Rudolphi.

?12. Dactylius aculeatus, Curling.

In this long list, however, not more than three or four demand any notice here, the remainder being for the most part exclusively intestinal parasites. We shall notice only—

1. Trichina spiralis.
2. Filaria medinensis.
3. " lentis.
4. Oxyuris vermicularis.

(1.) *Trichina spiralis.*—Although, strictly speaking, this worm is scarcely likely to become the object of surgical treatment, yet, as it may not unfrequently come under the surgeon's notice in the course of operations, and appears also occasionally to be productive of local symptoms, or to require exploration by surgical means for its detection, it may not be wholly out of place to take some notice of it. This curious parasite was first noticed by Mr. Hilton in 1832; and about the same time other cases were observed by Mr. Wormald and Mr. Paget. Portions of the affected muscles having been sent to Prof. Owen, the principal characters of the entozoon were made known by him. Numerous cases have since been published both in this country and abroad, and the subject has attracted the attention of many observers. Küchenmeister supposed that it might be the young state of *Trichocephalus dispar*, and we were ourselves at one time disposed to adopt this view; but later researches have fully shown that the two are perfectly distinct.

The entozoon may be regarded as peculiar to the voluntary muscular system. The muscles affected with it are seen on section, or even without, to be studded with innumerable minute yellowish-white specks of an elliptical form, the long diameter corresponding with the direction of the fibres. Each of these specks on examination will be found to contain a minute vesicle, in which is a coiled-up vermicule about one millimetre in length when stretched out. The cysts themselves vary somewhat in size, and are about one-third of a millimetre long. The cyst appears to belong to the worm itself, and not to be the product of any exudation in the surrounding tissue. *Trichinæ*, however, may exist in the unencysted condition in the flesh of animals without being visible to the naked eye, and even the cysts, before cretification has commenced, may easily escape detection without the aid of a lens.

It has been pretty satisfactorily proved that the chief source of the introduction of *Trichinæ* into the human system is the eating of trichinous pork, and more particularly so if the meat is raw or badly cooked. Even if in the form of sausages or hams—unless these have been long made and well smoked—the flesh of the pig when trichinized appears to be capable of communicating the germs. The vermicules are exceedingly tenacious of life, and retain their vitality even in decomposed meat, and after long immersion in water, or even in glycerine; and the cysts are so constituted as to be unaffected by moderately strong acids.

One of the most remarkable features of *Trichinæ* is the rapidity of their development. A very few days after the ingestion of trichinized meat the vermicules exhibit sexual distinction and maturity, rapidly produce their ova, from which while still within the parent the embryos are liberated, and commence active migration on their own account. This they effect by perforating the walls of the intestine and making their way to the voluntary muscles, where they become encysted, and thus complete the cycle of their existence. The whole process is apparently concluded within a single month, or even less. The genesis and migrations of *Trichinæ* are therefore astonishingly rapid, and it is no wonder that the sudden invasion of such a host of foes should occasionally give rise to grave disturbance in the system.

The invasion is often attended with a singular febrile affection presenting most of the characters of acute rheumatic fever, from which it is mainly distinguished by the absence of any articular affection. Local swellings of the muscles, especially of the calves of the legs, have been observed; and in doubtful cases an exploratory puncture and the abstraction of a minute portion of the muscles have been employed to settle the diagnosis.

[Trichina is common enough in the United States, infesting the hog, and indeed was first noticed in this animal in this country (Proc. Acad. Nat. Sciences, Philadelphia, 1846, 108). Thorough cooking destroys Trichina in pork, as it will all other parasites. It would appear that common sources of infection of the hog by Trichina are human excrement and rats; both of which the hog will eat with avidity.]

(2.) *Filaria medinensis.*—The well-known Dracunculus, or guinea-worm, is perhaps the most important, in a surgical point of view at any rate, of all the human entozoa. Although the greater part of the world is, happily, exempt, except occasionally, from its attack, in those regions in which it is endemic the guinea-worm may justly be regarded as one of the most pernicious pests to which mankind is exposed. Fortunately it appears, strictly speaking, to be indigenous in only a comparatively limited portion of the north tropical and subtropical zones; its geographical centre of diffusion being the continent of Africa south of the Great Desert, and north, as it would seem, of the equator. From this centre, however, it spreads more or less extensively into the contiguous parts of Africa, and to the opposite portion of Asia, extending as far north as the borders of the Caspian and into Central Asia, though how far to the east is uncertain. It is common in many parts of the Indian Peninsula, but more especially towards the west. The abundance of its occurrence in countries beyond the continent of Africa would seem, in fact, to bear some proportion to the amount of their direct communication with the Negro races. For the same reason it has become established in some of the West-India Islands, and especially, it is said, in the island of Curaçoa; and also on the continent in Demerara, and other parts of the mainland of tropical

America. But although a certain geographical range may thus be assigned to *Filaria medinensis*, it is nevertheless met with occasionally in all parts of the globe, and in individuals of every race; the only condition apparently necessary being that they should have visited some of the parts comprised in its endemic range within a certain period. It is consequently not unfrequently brought under the notice of the surgeon in this country and elsewhere; and as the effects produced by it are sometimes very grave, the subject of the guinea-worm is one of some importance to him.

Not to enter at too great length into the natural history of the worm, it may suffice to remark that from what is known of it there is every reason to conclude that the parasitic condition represents but one phase of an existence, some portion of which must be passed external to the human or any animal body. This circumstance leads to the consideration of the relations of the guinea-worm to other allied forms. Here we are at once struck with the close resemblance in many respects between its habits and those of several species of *Gordiacea*, or hair-worms, which at one period of their existence are found in the interior of insects or other animals, or even of grain. Several species of *Gordius*, *Mermis*, etc., are known, whose ova are deposited in water or moist earth; the embryos produced from which make their way into the bodies of aquatic or other insects, or of water-fowl, and there become developed into worms, often of considerable length. In the case also of the *Anguillula* of wheat, the larva, according to Davaine,[1] is known to exist for several months in water, and also to be able to endure complete desiccation for even several years without perishing. From these, therefore —and many more similar cases might be cited—we see that there is nothing unusual in the conditions we have presumed to obtain in that of the guinea-worm.

One important conclusion, in a practical point of view, to be drawn from this observation, is, that the guinea-worm cannot propagate itself directly in the tissues of its "host." *It is absolutely necessary for its multiplication that it should pass through some stage of existence external to the body.* And as this stage of existence may be supposed to demand conditions met with only in certain regions, but with which we are not at present fully acquainted, an apparent reason is thence afforded for its limited geographical range.

Some have supposed that there may be more than one species of guinea-worm, and Dr. M'Clelland[1] even thinks there may be many kinds in India alone. But at present, in our opinion, none of the reasons adduced in support of this notion are sufficient to sustain it.

In its parasitic stage the guinea-worm, when it has arrived at maturity—that is to say, when it contains active embryos of the full size—varies in length from about two feet, or less, to six feet, or even more, if we are to believe some accounts. It appears to be usually shorter, or to arrive sooner at maturity, perhaps, in Bombay than is observed in this country in the case of worms contracted on the coast of Africa. In the former locality the length appears to be about three feet; whilst from the latter, so far as our own observation extends, it is seldom less than six. It is cylindrical in form, and nearly white when quite fresh. The surface is smooth, although under a magnifying-glass it is seen to be marked with fine irregular circular rugæ. It is very tough and elastic, to which property, perhaps, more than to any muscular contraction, is due the retraction of the worm when suddenly broken off. In structure it may briefly be described as an elongated tube, open at one end only, and whose walls are constituted by an external integument, strengthened by four longitudinal muscular bands; whilst the interior is lined by the enormously dilated uterus, whose wall is scarcely distinguishable from the common parietes; between the two, however, runs a slender and inconspicuous intestinal tube. The mouth is a simple minute circular pore; and there is no anus. The internal cavity consequently represents the interior of what, were the animal sexual, would be the uterus. As it is, it is more properly comparable with the "redia" of a trematode, seeing that it produces, by a sort of gemmation, as it would seem, innumerable embryos, which are usually found in an active state in the midst of a grumous or pultaceous substance, and in all stages of development. The full-sized young are about the forty-second part of an inch in length, fusiform in shape, and tapering off rather suddenly into a slender elongated caudal portion. Internally they present traces of an intestine, which terminates, according to some, in an anus at about the junction of the middle and hinder thirds. Vestiges of other organs may also be discerned, to which it is needless here to refer. These minute creatures, when first extracted from the maternal body, are very active and vivacious when placed in warm water; they are also extremely tenacious of life, being capable, as shown by experiment, not only of living for many days in damp earth, but of enduring complete desiccation for a considerable time. The mouth of the young filariæ is merely a simple pore, and they have apparently no organs fitted for boring into animal tissues. The great similarity between these young guinea-worms and certain microscopic filaridæ, and especially one species among them, named by Dr. H. Carter *Urolabes palustris*,[1] has induced that excellent observer to consider it highly probable that they are identical. The species in question abounds in the mud of tanks and ponds about Bombay; and Dr. Carter relates many circumstances in support of his belief, that it is by the entrance through the integument of these minute Filaridæ that the guinea-worm effects its lodgment in the body. He further thinks that the young *Filariæ* enter through a sudoriferous duct, or a hair-follicle. Observation, however, has yet to show the true relation between these unarmed aquatic Filaridæ and the entozoon. In our view of the case probability would seem to be in favor of the notion that the Filaridæ in question do not themselves represent the future parasite; but that the active embryos of the latter, finding their way into the water or mud, develop sexual organs and produce ova, the embryos proceeding from which may or may not have a filariform aspect, and may or may not be furnished with some boring apparatus, but which, as in the case of *Mermis* and *Gordius*, enter the human body and become the guinea-worm, which would thus correspond to a "nurse" or "redia," as before remarked, and as was suggested by ourselves in 1845.[2] The male guinea-worm is at present quite unknown, and it will probably be found under a distinct guise from that of the female. It may be, and probably is, infinitely more minute than its mate, upon which it may even be parasitic, as in the remarkable case of the gordiaceous entozoon of the humble-bee, *Sphærularia bombi*, described by Sir J. Lubbock.[3]

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[1] Recherches sur l'Anguillule du Blé niellé, in Mém. de la Soc. Biol., 1856.

[1] Calcutta Journal of Nat. History, vol. i., 1841.

The above brief account of the natural history of the guinea-worm will serve to give an idea of the direction in which prophylactic measures are likely to be successful. Whether Dr. Carter's supposition be exactly correct or not, it is abundantly proved that the infection of guinea-worm is conveyed directly from without, through the integuments in the neighborhood of the parts in which it is found lodged. The notion entertained by some that it may be introduced through drinking-water seems to us to be devoid of all evidence or probability of its support.

[Notwithstanding this opinion of the author, it is the more common one in the countries in which the guinea-worm prevails, that it is introduced into the human body with the drinking-water. This view has recently been almost completely confirmed through the observations and experiments of Fedschenko, in Turkestan, made at the suggestion of Leuckart (Die Menschlichen Parasiten, 1876, ii., 704). According to Fedschenko, when the eggs of the guinea-worm are hatched, the embryos penetrate into the little crustacean, *Cyclops*, where they undergo further development and remain for some time. A single *Cyclops* accommodates from one to a dozen of the worms, and Fedschenko kept individuals alive in this condition for upwards of a month. It is highly probable that the infested *Cyclops*, when swallowed in the drinking-water, transfers the young worms for further development to the body of their new host. As the *Cyclops* is a common animal associated with multitudes of its kind in all stagnant waters, the discovery of Fedschenko gives an important hint to avoid these for drinking purposes, at least unless filtered.]

Symptoms and effects of guinea-worm.—The entrance of the worm into the body, however effected, is unattended with any observable symptom; and even when fairly lodged and growing rapidly in the tissues, the person affected is wholly unconscious of its existence until the period when it is ready to make its exit, or rather to discharge the cargo of embryos with which it is crammed.

The life of the worm as a parasite may consequently be divided into two periods, in one of which it is latent, and in the other manifests its presence by external signs.

The latent period would seem to vary considerably in duration, if we can rely upon all the reported cases; but in our own experience, which has been considerable, of cases as they occur in the country, the period is from ten to eighteen months, seldom less or more, and usually about twelve. During this period the worm resides in the cellular tissue, and probably in most cases at some depth from the surface; but this of course will vary according to the part invaded. In one case in which a guinea-worm fully six feet long was accidentally discovered lodged in the deep cellular tissue of the leg around the tendo Achillis, and which occurred under our own observation, no morbid symptom whatever was exhibited during life, nor after death was there the slightest appearance of irritation in the surrounding tissue.

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[1] Annals and Mag. Nat. Hist., 1859, vol. iv., p. 32.

[2] Microscopical Transact., vol. ii., p. 80.

[3] Linn. Transact., vol. xxiv., p. 101, pl. 21, 22.

When arrived at maturity, the worm makes its presence and the place of its intended appearance known by various symptoms, such as itching and slight swelling, usually circumscribed, but sometimes diffuse, and which gradually assumes the aspect of an inflamed pustule or boil. These symptoms are, in some cases, attended with considerable constitutional disturbance, and with severe lancinating deep-seated pains; but this is by no means always the case. When left to itself, the worm invariably presents itself head first. On this account, unless an opportunity (which rarely occurs) be afforded of seeing the case before the pustule is opened, the head is usually destroyed. The after progress of the case depends very much upon, 1st, the general state of health or habit of the individual; and 2dly, on the mode in which the extraction is conducted. The latter proceeding is usually effected by winding the protruded portion of the worm round a piece of wool, quill, or bougie, day by day, so long each time as it yields to gentle traction. The animal is tolerably tough and highly elastic, as before said, and will consequently bear a considerable amount of stretching without risk; but, for the same reason, should the force employed be too great, the worm when broken is immediately withdrawn to a great depth. This event is usually followed by considerable deep-seated inflammation and suppuration, which is liable to be succeeded by extensive sinuses and sloughing of the cellular tissue, sometimes requiring long and deep incisions. In these cases there is reason to believe that the remainder of the worm has perished, and that the wide-spreading irritation is due to its presence as a dead and decomposing foreign body. In other cases, however, when the worm retracts in the same way, but in which it does not so perish, the original orifice may close up with little or no signs of irritation of the deeper tissues, and after a time the entozoon will show itself at another distant part of the surface in the same way as at first. In India it would seem that the more experienced native practitioners are skilful in cutting down upon the worm when near the surface, and are thus enabled to seize it by the middle, and to effect its extraction very speedily. It sometimes happens also that the entire worm may be coiled up close to the point of exit, and may thus be removed *en bloc*; but it is far more usual to find that the extraction is a long and tedious proceeding, demanding great care on the part of the surgeon, and considerable patience and fortitude on that of the patient.

(3.) *Filaria lentis.*—Cases are recited of the occurrence of minute filariform worms in the orbit and within the eyeball itself. Some of these, and especially those in the former situation, may not improbably be instances of immature guinea-worm; whilst those met with in the interior of the globe would seem to belong to a different species altogether. Very few cases, however, of this kind are recorded. In three of these the minute *Filaria* was seated in the crystalline lens, or rather perhaps between the lens and its capsule; and in one its habitation was the anterior chamber. To this minute worm, about whose structure and natural history we have no further information, the name of *Filaria lentis*, or *oculi*, has been applied. It may perhaps turn out to belong to the genus *Trichina*.

[*Filaria loa.*—A thread-worm, apparently distinct from the guinea-worm, has been reported as infesting the inhabitants of Gaboon, Congo, and Angola, West Africa. It is about an inch in length, and has been commonly observed under the conjunctiva. Dr. R. H. Nassau, missionary at Gaboon station, says it is common in the vicinity, and also occurs beneath the skin of the hands. It has been introduced into America, and has been observed in negroes in Brazil, San Domingo, and other places. Those infested are said to remove the parasites by means of a thorn.

Filaria sanguinis.—In 1872, Dr. T. R. Lewis,[1] in a report to the Government of India, announced the occurrence of innumerable minute worms in the blood of persons laboring under certain diseases. These worms, described under the name *Filaria sanguinis hominis*, are about one-seventy-fifth of an inch in length. Subsequently many cases of a like character have been reported by Lewis, Manson, Silva Lima, and others, of persons infested in India, China, Brazil, and other tropical countries. From the evidence of these observers, it would appear that the blood parasites produce many grave affections, as "chyluria, endemic hæmaturia, varix, elephantiasis, lymph-scrotum, and lymphoid affections generally, a growth called helminthesa elastica, a cutaneous disorder called craw-craw, and also leprosy." The same worm has been detected in mosquitoes which have sucked the blood of infested persons; and in the mosquitoes the worms have been observed to undergo further development. From this it is inferred that the mosquitoes transfer the worms to water, from which persons

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[[1] The Pathological Significance of Nematoid Hæmatozoa. Calcutta, 1874.]

drinking it become infected. Cobbold considers the blood-parasite as the young of a species described by him under the name of *Filaria Bancrofti*, a hair-like worm, several inches in length, obtained from the blood of a person affected with chyluria, in Australia. Dr. Bancroft, who furnished the specimen, has since reported other cases in which the parasite was obtained from lymphatic abscess and hydrocele. He also states that he has on record twenty cases of the parasitic affection; and adds that he believes it will be the solution of chyluria, one form of hematuria, one form of spontaneous lymphatic abscess, a peculiar soft varix of the groin, a hydrocele containing chylous fluid, together with some forms of varicocele and orchitis.[1]]

(4.) *Oxyuris vermicularis.*—The common thread-worm, though properly an inhabitant of the lower bowel only, may occasionally come under the cognizance of the surgeon when it has found its way into the female vagina, or wandered into loose mucous folds external to the anus, where, as in a case mentioned by Cruveilhier, and cited by M. Davaine,[2] it may give rise to considerable annoyance. Another circumstance also connected with the presence of thread-worms is the sympathetic irritation sometimes said to be produced by them upon the sexual organs, leading, according to Lallemand,[3] to frequent seminal emissions and other evil consequences.

[Of Oxyuris vermicularis, Cobbold (p. 230) remarks: Infection ordinarily takes place by the accidental conveyance of the eggs that are lodged in the neighborhood of the victim's anus to the mouth. The transfer may be made involuntarily through scratching the parts during sleep. According to the investigations of Zenker and Heller, the eggs are hatched in the stomach, and the embryos undergo transformation in the small intestine, and are finally transferred to the cæcum.]

(5.) *Doubtful and false nematoid entozoa.*—Among these may be enumerated.

a. Strongylus gigas.
b. Spiroptera hominis.
c. Dactylius aculeatus.

(*a*) *Strongylus gigas.*—In the kidney and urinary passages of several animals, both carnivorous and herbivorous, but more especially the former, such as the dog, wolf, jackal, polecat, ox, horse, and otter, and more rarely in the abdominal cavity, a large-sized nematoid worm, distinguished by certain characters from *Ascaris* and *Oxyuris*, has been often observed. [It is very common in the kidneys of the mink.] In dogs it is known to produce various symptoms of urinary disorder. Several cases of a nematoid worm in the same situations in man are recorded by authors; but these accounts are all either of such remote date, or so imperfect, that it is impossible from them to conclude whether the worm in question be really identical with that of the animals above mentioned, or another species of the same genus, or whether, as is not improbable, in all the human cases, some confusion has not arisen with the common round worm, *Ascaris lumbricoides*.

(*b*) *Spiroptera hominis.*—The only case of the occurrence of this supposed entozoon is that related by Sir W. Lawrence,[1] of a woman in St. Sepulchre's Workhouse, who was said to pass worms from the urethra; and they were occasionally even drawn off through the catheter, so that no doubt as to any deception was at the time entertained.

Recent examination, however, by Dr. Schneider[2] of the specimens which had been forwarded to Rudolphi, and are still preserved in his collection at Berlin, has shown that the grossest deception must have been practised by the patient. The objects were contained in three bottles. In the first they turned out to be the specimens of common *Filaria* (*Agamonema*) *piscium;* in the second, which contained what Rudolphi terms "concrementa lymphatica," they were apparently fine shreds of some intestine; and in the third bottle were the ova of some fish. It was the latter that were said to have been brought away through the catheter. *Spiroptera hominis*, therefore, should be removed from the list of entozoa.

(*c*) *Dactylius aculeatus.*—The vermiform creature described under this name by Mr. Curling,[3] as having been passed in the urine of a female child of five years old, from the figure and description obviously belongs to the chætopodous worms, and has no claim whatever to be ranked among the entozoic nematoids.

III. *Arachnida.*—The only forms belonging to the arachnida that can properly be regarded as human parasites, although many others may occasionally attack the human subject, are:—

1. Acarus (Demodex) folliculorum.
2. Sarcoptes (Acarus) scabiei.

Both of these, however, have been already considered under cutaneous diseases or eruptions, and will therefore be passed over in this place.

[[1] Cobbold, Parasites. London, 1879, 184.]

[2] Op. cit., p. 211.

[3] Des Pertes séminales involontaires, t. iii.

[1] Med.-Chir. Transact., vol. ii., p. 385.

[2] Müller's Archiv, 1862, p. 275.

[3] Med.-Chir. Trans., vol. xxii., pp. 274 and 282.

IV. *Insecta.*—The same, with one exception, may be said of the parasitic insects, of which we will content ourselves with giving a list only.

1. Pediculis capitis.
2. " vestimenti.
3. Phthirius pubis.
4. Pulex irritans.
5. " penetrans.

We shall concern ourselves here only with the last.

Pulex penetrans, the Sand-flea (chigoe, chigger, or jigger), is considerably smaller than the common flea, and has a proboscis as long as the body. The male, and also the female until impregnated, lives solely in sand, and does not attack man; but the impregnated female is one of the worst pests in the West Indies, and in many parts of South America. Humboldt states that it only attacks Europeans, and not the aborigines; but there is no doubt it is as much attracted by the Negro as by the white man. The impregnated female introduces itself between the nails or between the toes and other parts of the naked foot, and soon enlarges into a white globular vesicle about the size of a pea, by the rapid growth of the ova or rather larvæ, which are formed and contained in a membranous bag beneath the abdomen. The presence of this rapidly growing intruder causes considerable irritation and annoyance, and if the distended orifice be incautiously ruptured, the escape of the numerous progeny into the surrounding tissues is often followed by suppuration and tedious ulceration. The treatment, which requires some skill and sharp eyesight, consists in dilating the orifice through which the insect has entered, with a needle, and carefully extracting it whole.

B. Vegetable Parasites.

A considerable number of vegetable parasitic growths have been enumerated as infesting man as well as many other animals, and affecting both the external surface of the body and some of the internal mucous passages which are exposed to the air. These growths belong, for the most part, to the hyphomycetous fungi, and, with perhaps one or two exceptions, amongst which the fungus peculiar to *favus* should, in our opinion, undoubtedly be included, they are in all probability, merely different forms of the common mould (*penicillium glaucum*), or of other minute fungi of a common kind. At any rate, as they all, or nearly all, are closely connected with certain cutaneous affections which have been treated of elsewhere, it will be needless here to say anything concerning them. It is far otherwise, however, with a particular form of fungus, which appears to constitute the essence of a very serious surgical disease in the East.

In the Transactions of the Medical and Physical Society of Bombay, No. VI., for 1861, p. 104, will be found an elaborate paper by Dr. H. Vandyke Carter, concerning a "New and striking form of Fungus-Disease principally affecting the foot, and prevailing epidemically in many parts of India."

Though the nature of this extraordinary affection is for the first time explained in this valuable paper, the affection itself appears to have long been noticed by Indian surgeons as one of a peculiar kind. It was distinguished in the medical reports under the name of "ulcus grave," "morbus tuberculosus pedis," "Madura-foot," "peculiar tubercular disease," etc. The disease appears to be of not unfrequent occurrence in the Bombay and Madras presidencies, and since its nature has been made known cases of it have been met with also in Bengal. It appears, therefore, to pervade most of the hotter parts of the Indian Peninsula. It attacks men far oftener than women, and is almost exclusively confined to the feet.

Dr. Carter distinguishes at least two varieties of the affection; and the account he gives of a case[1] will serve very well to afford an idea of the appearances produced by it. The subject was a Hindoo farmer, aged about thirty-five years, residing near Poona, in the Deccan. When admitted into hospital on September 21, 1859, his right foot was much enlarged, particularly about the ankle; the general form of the swelling was oval, somewhat resembling that of extensive scrofulous caries of the part; the skin was thrown into coarse corrugated wrinkles. On either side of the ankle-joint and on the dorsum of the foot, near the toes, and also in the sole, were numerous small soft swellings or tubercles as large as a pea or marble, having puckered apertures or fistulous openings; and at these points the skin appeared lighter in color than elsewhere. The tubercles were in all stages, from a slight elevation of the surface to an acuminated point, and there a puckered fistulous orifice appeared. A probe introduced into one of these openings entered a long but not tortuous sinus, many of which led to bare bone. A discolored glairy sero-purulent fluid exuded on pressure, frequently mixed with a few black gritty particles. The toes were distorted and displaced upwards, and the muscles of the calf were atrophied. The disease was of twelve years' standing, and the history given was this: when wading in a nullah, or water-course, a thorn stuck in the sole of the foot, bleeding followed, and an abscess formed the size of a walnut. The swelling began to spread, without much pain, from the sole of the foot and toes towards the ankle. Amputation was performed, and the patient made a complete recovery.

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[1] Loc cit., p. 111.

On section of the parts after removal, the disease was at once seen to be characterized by the presence of numerous black masses, studded throughout both hard and soft parts. There was no deposit in the cancelli of the bones, and no blending of the parts, as observed in cancer; and the black masses could be picked out quite clean from the cavity or space in which they were contained, and which was lined with a membrane. There was no appearance of caries, the osseous tissue having been removed apparently only by absorption. Nor was there any alteration or thickening of the soft parts, such as occurs in elephantiasis, etc.

In the second variety, although the external appearances are not unlike, a considerable difference exists in the absence of the black masses. The bones are affected nevertheless in a similar way, and a fungus is also to be found. In a case recorded[1] of this variety, the "diseased parts consisted of collections of what looked like sloughing tissue; gray or blackish masses, almost glairy in consistence and accumulated in loculi, from which they could be readily drawn out, whether in the soft parts or in the bones, which were excavated to receive them. No black granules were seen, and only after a careful examination were white granules detected in the interior of the loculi."

The discharge from the sinuses was examined, prior to the amputation, by the microscope: it presented, together with blood-corpuscles and granule-cells, numerous small bodies barely visible as white dots to the naked eye; but when magnified, appearing rounded and tuberculated, of a yellowish tint, and slightly varying in size. These were the fungi.

In some cases, where the disease is still more advanced, the destruction and obliteration of parts is still greater; till at last scarcely any remains of the original tissues either hard or soft are recognizable. The general characters of the affection are thus summed up by Dr. Carter:—

1. *External appearances.*—Globular, or flattened form of swelling, often very considerable; never extending above the foot. Skin first studded with blebs or soft tubercles marked with numerous sinuous apertures. A thin discharge, often scanty and watery, and generally containing small granules or particles, either barely visible or distinct, soft, and like poppy-seeds, or black in color.

2. *Appearances on dissection.*—General confusion of parts, owing to absorption of the bones, and fibrous thickening of the soft parts. Often the presence of granules, separated or aggregated into mulberry-like masses of a yellow or brown color, lodged in spherical cavities excavated in the bones or soft parts, or in tunnels or channels leading from the cavities to the openings on the surface, and also lined with a membrane.

Sometimes there is a deposit of a fleshy substance, containing numerous minute particles (white or red), and occupying the same localities as the above-mentioned granular deposit. Lastly, in the same cavities and tunnels may be found black granules, spheroidal tuberculated masses of the same color, and radiated in structure.

Dr. Carter adduces many considerations to show that this curious parasitic fungus is introduced from without, and draws a close comparison between the mode of its invasion and reproduction and that of the guinea-worm, which is highly interesting, but too long for notice here.

Masses of the truffle-like fungoid tubera having been furnished to Mr. Berkeley, that eminent fungologist has procured from them the mycelium and fructification, and has thus determined the botanical characters and systematic position of the fungus, to which he has given the name of *Chionyphe Carteri.*[1]

Amputation of the affected part appears to be always successful in putting a stop to the extension of the mischief.

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[1] Loc. cit., p. 115.

[1] Intellectual Observer, vol. ii., p. 248.

VENOMOUS INSECTS AND REPTILES.

By G. Busk, M.D.

Revised by Joseph Leidy, M.D.

Under this head is included the consideration of wounds inflicted by animals, into which some poisonous or irritating material is introduced. In this country and in many others the subject is one of little importance; but in some, more especially in the warmer regions of the globe, it demands the serious attention of the surgeon. But from the great general similarity, except as regards degree of severity, in the effects produced by wounds of this kind, and as their treatment is to be guided by obvious and simple principles, there is neither room nor need for any extended observations on the medical or surgical aspect of the question. But we have thought that some space might be usefully occupied in pointing out the different classes of animals amongst which venomous species are found, and in indicating those species more especially whose attacks are most to be dreaded.

A. Invertebrata.

Poisoned wounds inflicted by insects and arachnida.—In this section might be enumerated a considerable number of species whose bites or stings are attended with a greater or less degree of irritation and inflammation; but from the trifling nature of the injuries inflicted by most of them, it is unnecessary here to notice any but those whose attacks are attended with what may be termed serious effects.

Considered in this regard, the most formidable of the venomous invertebrate animals belong to the classes arachnida and myriapoda. Under the former are included the scorpion, of whose venomous properties there is no doubt, and several spiders, whose evil reputation rests perhaps upon less certain grounds. The only myriapod that can positively be said to possess any venomous power is a species of scolopendra (*S. morsitans*).

(*a*) *The Scorpion* (*S. europæus*, *S. occitanus*, etc.)—The scorpions (Scorpionidæ) are characterized by their elongated jointed caudiform abdomen, which is armed at its extremity with a hooked claw. This claw, which is perforated and connected at the base with poison-glands, constitutes the *sting*. In the lower species, inhabiting the hotter regions of the globe, the effects of the scorpion's sting in man appear to be very serious, if not in some cases actually fatal; and even in the smaller species found in the south of Europe its effects are very unpleasant, and not altogether unattended with danger to delicate or irritable individuals. The symptoms produced by it very much resemble those produced by the stings of bees and wasps in an aggravated degree: such as acute pain, a general nervous shock attended with numbness, vertigo, occasionally temporary loss of sight, vomiting, etc.; whilst the local symptoms are swelling and other signs of acute inflammation, followed in many cases by suppuration, sloughing, and their consequences.

The remedy which appears to have obtained the greatest repute, and to be recommended by the most trustworthy evidence, is the application of ammonia externally, and its internal administration as a stimulant also; although it is probable that any other diffusible stimulus combined with opiates would be equally, if not more, efficacious. A variety of plants, belonging more especially to the Cruciferæ, have also been supposed to possess useful properties in the treatment of the effects of the scorpion's sting.

(*b*) *Centipedes* (*Scolopendridæ*).—Several species of *Scolopendra* enjoy the reputation of being highly venomous; and there is, perhaps, no doubt that the bite of some of the larger kinds, and especially of *S. morsitans*, a large species inhabiting the hotter regions of the globe, has occasionally been attended with very troublesome and painful consequences. The poison of these creatures is conveyed not by a caudal sting, as in the scorpions, but by somewhat similarly-formed curved fangs connected with the mandibles, which are perforated, and probably communicate with special poison-glands, although the existence of such organs does not appear as yet to have been satisfactorily made out. The bite of the centipede, though described as excessively painful, does not seem to be usually followed by the same severe symptoms as is the sting of the scorpion; and it is not improbable, therefore, that no poison is actually introduced.

(c) *Spiders* (*Araneida*).—The bite of several species of spiders is said by various writers to be venomous: but the testimony, speaking generally, upon which this property is attributed to them does not appear to be very conclusive.

Spiders have from time immemorial enjoyed the evil reputation of being highly poisonous when swallowed, and very powerful medicinal properties have even been assigned to their webs. These notions, however—no doubt due to the disgust felt by most persons at the sight of such ugly creatures—are of course totally unfounded; nor, perhaps, with one or two more or less problematical exceptions, does there seem to be any better reason for believing that their bite inflicts more than a simple wound.

One or two species, however, deserve more particular notice.

The first of these, the Tarantula or Tarentula (*Lycosa tarentula*), a large spider belonging to the tribe of citigrade, or running spiders, and which abounds in Southern Europe, and more especially in South Italy, has long acquired an extraordinary, but as it would seem wholly undeserved, infamous reputation. The concurrent testimony of all competent observers has conclusively shown that the extraordinary stories of the affections produced by the bite of the Tarantula, and of the no less extraordinary methods of cure adopted, are the records either of wilful deception or of the strange pranks the imagination may play in the apparent production and removal of morbid symptoms. Direct experiments in various hands show that the bite of this spider is unattended with any ill effect beyond slight local irritation.

Another spider, belonging to an entirely different tribe, but which is also found in the south of Europe, is said to produce a similar train of symptoms to those attributed to the *Tarantula*, and doubtless having the same origin.

A third species (*Aranea* 13-*guttata*) is also reputed to inflict a very dangerous and even fatal bite both upon men and domestic animals in the island of Elba; and in Morocco a spider, there called the *tendaraman*, has had equally formidable venomous powers attributed to it. It is said to be common in the cork-forests; and that its bite is so poisonous that the persons bitten by it survive but a few hours. But we may surely be allowed to doubt all such stories; especially when we learn that the spider always makes towards the head in order to inflict its deadly wound.

(*d*) *Venomous insects.*—A great variety of insects appear to have the power of inflicting wounds attended with a greater or less amount of local irritation. But whether in the majority of these cases any poison is actually introduced into the punctures made by their lancet-like proboscis appears to be by no means certain. It is highly probable that the effect, as is often the case with leech-bites, is due to prolonged mechanical irritation only. It must be confessed, nevertheless, that in other cases the severe pain which attends the bites of very minute creatures can scarcely be accounted for, except on the supposition that they are accompanied with the introduction of some irritating, if not actually venomous material; as of formic acid, for instance, in the case of ants; or, perhaps, of an acrid salivary secretion in other insects.

In some cases, however, it would seem that certain insects are capable of affording a truly poisonous matter of a septic and diffusive nature, by which, independently even of any local irritation, the whole system may be fatally affected. The most remarkable case of this kind is that of the dipterous fly termed "tsetse" (*Glossina morsitans*), of whose ravages, or supposed ravages, we have so graphic though unsatisfactory an account in Dr. Livingstone's travels. It is true that this fly is innocuous to man; but nevertheless, its alleged effects upon certain animals are so extraordinary, and it might almost be said so incredible, as fully to deserve some notice in this place. The Tsetse is a harmless-looking insect, very little larger than a house-fly; but its bite is said to be certain death to domestic cattle, the sheep, horse, and dog, whilst it is innocuous not only to man, but to the goat, antelope, ass, and pig, as well as to all wild animals whatever, and even, what is stranger than all, to the calf so long as it is sucking. The symptoms attributed to the bite of the Tsetse do not arise immediately, but after an interval sometimes of several weeks. They appear to commence with a general disorder, attended with weakness and wasting, running at the nose and eyes, and glandular swellings under the jaw. The animals so affected invariably waste away and perish. The affection is said to be quite different from the "leg-sickness," and other murrains, which are so common in South Africa; and to present this striking difference from them, that it is not contagious. A herd of healthy cattle is not infected by animals laboring under the effects of the tsetse-bite. Nor is an animal ever affected in the same way unless it has been into a district of country infested by the fly. These districts are described as being very distinctly defined, although separated from a healthy one sometimes only by a narrow river, or even by an imperceptible boundary. Nothing appears to have been ascertained with respect to the infested tracts of country being inhabited by any peculiar plant or vegetation; but, on the other hand, travelers seem to have convinced themselves that the tsetse-fly is never found except in districts inhabited by the elephant and rhinoceros; and that in proportion as those animals are destroyed, do the ravages of the fly diminish. It is much to be desired, however, that the subject should be further investigated.

Dr. Livingstone also mentions another insect, whose bite produces vomiting and purging in the human subject; but as he enters into no particulars, we can merely notice the circumstance as one, if truly reported, of a very remarkable kind.

But although the bites of insects are comparatively so innocuous, it is otherwise with their *stings*. Stinging insects belong chiefly, if not exclusively, to the order hymenoptera, in which the sting, in the sterile females, represents the modified ovipositor. The instrument consists essentially of two exceedingly fine and sharp darts, enclosed in a tubular sheath, at the base of which is placed a special venom-gland or sac, whose contents are injected into the wound made by the usually serrated or barbed darts. The well known consequences of the sting of the bee, wasp, and hornet are too familiar to require particular notice. Though painful and annoying, these wounds, except in cases of persons attacked by numerous swarms, can rarely be accounted serious, though the effects vary a good deal in different persons, and probably are more severe in warmer climates. When large communities of hymenoptera, however, are disturbed, and the assailant is attacked by great numbers of the angry members, very severe consequences, and even death itself, have often followed; and in one instance at least, the sting of a single insect (*Mutilla coccinea*), a native of the warmer parts of North America, is said to produce loss of sense within five minutes after its infliction, and considerable apparent risk to life for several days afterwards.

Various remedies of a domestic nature are recommended to allay the smart and inflammation attending stings; amongst which vinegar, ammonia, flour, indigo in the form of the "blue-ball" of washerwomen, oil, spirit, eau-de-Cologne, etc., may be enumerated. Of these, ammonia in the form of sal-volatile or eau de luce is perhaps as good as any.

B. VERTEBRATA.

Wounds inflicted by venomous snakes.—Of a far more important character than those noticed in the preceding section are the poisoned wounds inflicted by animals belonging to the vertebrate sub-kingdom. Fortunately, as compared with the whole number of vertebrata, these are not very numerous, nor are they very powerful, except in the possession of their lethal weapons; and as they are for the most part slow of movement, and of a sluggish and retiring nature, they are not to man, at least in one sense, of any very great importance. The serious and often fatal nature of their attacks, however, render the subject of the wounds inflicted by them one of considerable interest and moment, especially in countries where the more powerful species are met with.

All the truly venomous vertebrata belong to the order of ophidian reptiles; to some few points with respect to the natural history and organization of which, bearing upon the main subject of this section, we shall therefore now proceed to refer as briefly as possible.

Characteristics and classification of venomous reptiles.—Many systematists have begun their classification of the Ophidia by dividing them into the *innocua*, the *suspecta*, and the *venenosa*. But the exigencies of more recent zoological science demand a more exact classification than is afforded by such an artificial arrangement. Not to enter at any length into the principles upon which various schemes for their classification have been based, it will, for our present purpose—that of diagnosing venomous from non-venomous snakes—be sufficient to remark that the Ophidia are very naturally subdivided into two large groups or sub-orders, clearly distinguished from each other by various particulars in the organization. In one of these sub-orders all the species of which it is composed are more or less venomous; whilst in the others the majority are innocuous in that respect, though some are truly formidable in other respects.

The former group of true venomous snakes have been termed the *Viperina*, or viperine snakes, of which the rattlesnake and viper are familiar examples; whilst the second have been denominated the *Colubrina*, of which the common harmless ringed snake of this country is a specimen.

It will be useful briefly to state the chief characteristics of each sub-order.

Characters of the Viperina.—As has been remarked, all the members of this sub-order are venomous; any snake therefore exhibiting the following characters may at once be so regarded; the body is comparatively thick and clumsy; the general aspect sombre and lurid; and the usual movements sluggish and dull. The tail or part of the body behind the anus is thick and very short; the head broad, depressed, and triangular, or cordiform, joined to the trunk by a constricted neck, and covered on the summit not with plates or scutes, but with small scales, and having the integument usually loose and wrinkled; the eyes are small, wholly lateral, deeply lodged on the sides of the head, and shaded above by prominent overhanging supraciliary rugose or tuberculated plates; the pupil is elongated and vertical; the upper lip descends on either side like that of the mastiff, so as to conceal the poison-fangs; the scales, lastly, are in almost every instance distinctly carinate or muricate. By these general external characters a viperine snake may usually readily be distinguished; but closer examination of the internal structure of the head and oral organs will disclose still more decisive characters. The chief points to be remarked here are the shortness and extreme mobility of the maxillary bones, each of which supports a single long-pointed and recurved tooth perforated throughout its entire length by a slender canal, and which is termed the poison-tooth or "fang." By a peculiar arrangement of the maxillary bones and muscles, this tooth when not in action can be reclined into a groove in the gum, where it is completely concealed, or it can be suddenly and forcibly erected when the animal is preparing to strike its deadly blow. The rest of the bones connected with the jaws, face, and gullet are in a corresponding manner very loosely articulated, and so disposed as to admit of enormous dilatation of the mouth and entrance into the pharynx. Besides the fangs, the upper jaw contains no teeth, although a series of pointed recurved solid teeth occurs along the palate. In the lower jaw similar teeth are found at the extremity.

The *fang*, as has been said, is traversed by a narrow canal, continuous above with a sort of pouch or *sacculus* surrounding the base of the tooth, into which opens the long curved duct of the *poison-gland*. This organ, which with various modifications may be described as composed of tubular follicles communicating with a common canal, and consequently as quite distinct in structure from an ordinary salivary gland, has a thick aponeurotic wall surrounded by muscular fibres, in most cases apparently connected with the temporal muscle, and which are supposed to act as compressors of the gland and ejaculators of its contents. It is usually placed below and a little behind the orbit; but in one remarkable instance—*Causus rhombeatus*—the poison-gland, which is of enormous size, is situated on the back, extending from the nape through nearly one-sixth of the entire length of the body, lying immediately beneath the integument and superficial to the ribs and their muscles.

The Colubrine Snakes, among which are included the Hydrophidæ or Sea-snakes, differ in several important particulars from the Viperina. In external form they are usually slenderer and more elongated, especially in the caudal region. The head is smaller or narrower in proportion, and in nearly every case continuous, as it were, with the body, and in all the more important members of the sub-order covered on the summit with large scutes or plates, usually nine in number; the scales, except in the Sea-snakes, in which they are tuberculate, are smooth and non-carinate; the eyes are larger in proportion than in the Viperina, and except in one or two genera, have an orbicular pupil. To these general external characters may be added that their movements are more lively and active, and their colors in most cases more brilliant and pleasing. Important differences also exist between the two groups in the structure and connections of the cranial and facial bones, and especially in the dentition, in which their great distinction exists. Among these differences we may briefly notice the greater strength and compactness of articulation of the jaws and other bones connected with them, by which the oral cavity and gullet are rendered far less dilatable than they are in the Viperina; and the greater length and size of the maxillary bones, which are furnished with numerous solid conical fixed teeth.

This great sub-order includes by far the largest number of snakes, varying in size from that of an earth-worm to the gigantic dimensions of the Boa-constrictor and great Pythons. Fortunately, few of these genera of snakes are venomous; but among those which are so, we find some of the most formidable of all. With the exception of the Sea-snakes or Hydrophidæ, all of which are reputed to be highly venomous, and are at once distinguishable by their exclusively marine habitat, vertically flattened form, and fish-like habits, it is not easy to lay down in words any very accurate means of distinguishing the venomous from the non-venomous Colubrina. The former usually have the muzzle larger and blunter than the rest; the trunk more elongated, and the tail shorter, stunted, and conical; the eyes smaller, and in some cases with a vertical opening, although the pupil is always round; the nostrils wide and lateral, etc. But the more important species of this group, or those belonging to the genus *Naja*, are characterized by the faculty they nearly all possess of expanding the sides of the neck when in an excited state, whence they are sometimes distinguished by the appellation of hooded snakes, or Cobras da capella. The essential character, however, by which the venomous are distinguished from the non-venomous Colubrina, is the development in the upper jaw of the former of one or more of the anterior maxillary teeth into poison-fangs. As we have said before, these teeth are always fixed or non-reclinable; and they differ also from the true poison-fangs of the Viperina in not being perforated down the centre by a canal, but are adapted to the purpose of conveying poison into the wound by a groove on their anterior or convex side, which is in connection—much in the same way as the canal in the viperine fang—with a special poison-sac or gland; the chief difference being that the duct is short and straight, instead of long and curved, as in the latter case.[1]

Nature of the "venom," and its effects.—Having thus briefly surveyed the general characteristics of venomous reptiles, we shall proceed to say a few words respecting the nature of the poisonous secretion itself, and to describe the effects which follow its introduction.

The venom of serpents is described, when fresh, as a transparent yellowish or greenish subviscous neutral fluid, very much resembling saliva. In other sensible properties it is said to be insipid, and almost inodorous, and, in fact, to exhibit no obvious character denoting its virulent properties. It is heavier than water, and not very readily miscible with it; the mixture when shaken becoming turbid. According to Prince Lucien Bonaparte, it contains, besides albuminous or mucous and a small amount of fatty matter and the usual salts, a peculiar principle, to which he has given the name of "echidnine" or "viperine," but which appears, in most of its characters, strongly to resemble ptyaline. It is said, however, to possess active poisonous properties, which are retained even after it has been dried for a considerable time, if not exposed to the air. But, however simple in appearance and composition this fluid may be, it undoubtedly possesses the most energetic and remarkable physiological properties.

In the first place, it appears to be quite certain that the poison produces no effect, or scarcely any, beyond a temporary irritation of the passages, when introduced into the stomach; the only exception to this being some instances in which it would seem that pigeons were stupefied for a short time after being made to swallow it; at any rate its introduction in this way never seems to be followed by any very serious consequence. Nor does it produce any deleterious effect beyond, in some cases, a little local irritation, when applied to the surface of the skin, even when it has been slightly abraded. It would also appear, from Fontana's experiments, that it is innocuous when applied to an exposed surface of muscular tissue, to cartilage, the pericranium, periosteum, the dura mater, to the medullary cavity of bones, the cornea, tongue, lips, palate, etc. Applied to exposed nerves, it is equally inert; nor does it apparently affect the irritability of detached muscle. In fact, it may be said that the general result of experiment and observation tends to show that, in order to produce its specific effect, the poison must be introduced directly into the subcutaneous cellular tissue, though even here curious anomalies have been observed; amongst which is the circumstance that direct inoculation with the aid of a cutting instrument is less likely to succeed than when the poison is introduced through the fang itself. This, of course, may be owing to the greater outflow of blood in one case than in the other.

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[1] Besides the undoubtedly venomous snakes above referred to, there is a large class of ophidians, with grooved or channeled teeth, with respect to whose venomous or non-venomous properties the opinions of naturalists have been, and are still, much divided. In these snakes, which have by some been termed "*suspecta*," the channeled teeth are situated, not in the front of the upper jaw, as in the truly venomous serpents, but behind. It has been conclusively shown in many cases, and can hardly be doubted in any, that the channeled teeth are in connection, by means of a special duct, with a considerable-sized gland, with regard to whose nature it is that opinions have been chiefly divided. Whilst some eminent observers, as Johannes Müller, Milne-Edwards, and Duvernoy, ascribe to it the structure and functions of a true poison-gland, others, as Schlegel, Andrew Smith, Owen, and more recently A. B. Meyer, describe it as having the structure and presumably the functions of a simple salivary gland. The accounts of travellers, also, respecting the effects of the bite of this class of snakes, are fully confirmatory of its non-poisonous nature in the majority of cases. But quite recently (Monatsbericht der k. k. Ak. d. Wissenschaft, Berlin, März, 1869), it has been shown by the last-named author, that in at least two species of the most innocent-looking snakes (*Callophis intestinalis*, and *Callophis bivirgatus*) the posterior channeled teeth are connected with enormous true poison-glands, much larger, in fact, than those of *Causus rhombeatus*, and which, strange to say, are lodged, not superficially, as in that species, but within the cavity of the ribs, and in front of the heart, occupying nearly one-quarter of the length of the body. Although extended investigations have as yet failed to show the occurrence of similar organs in any other species of the "*suspecta*" than those above named, it is not improbable that such may exist, and consequently in the case of any unknown snake it will be prudent to adhere to the old maxim of *fronti nulla fides*.

When properly introduced, however, its effects are very rapidly manifested; in fact, in some cases so rapidly, as more to resemble those of prussic-acid than anything else; usually, however, a brief interval elapses before the effects are shown. These may be divided into general and local. The first symptom, in nearly all cases, appears to be a general shock to the nervous system, attended with faintness, tremor, and great depression—sometimes with stupor, loss of sight, vomiting, trismus, and general insensibility; at the same time great and sometimes intense local pain is set up. The limb, if the wound is in one of the extremities, rapidly swells; at first pale, the surface of the swelling soon becomes red and afterwards livid, and covered with phlyctenulæ filled with sanious fluid. In severe cases the swelling continues to spread through the whole limb, till it reaches the trunk or even the entire body, whose surface assumes a jaundiced hue. The symptoms, in fact, very closely resemble those of ordinary phlegmonous erysipelas, or diffuse inflammation of the subcutaneous cellular tissue. The constitutional symptoms, independently of the first shock, are what might be expected to accompany such a local affection, and in intensity are in proportion to its violence.

The gravity of the effects of the bite of a venomous snake appears to be in direct ratio to the comparative sizes of the snake and its victim, and also to the quantity of poisonous secretion, present at the time in the saccular gland. It is also greatly governed by the situation of the wound; one on an extremity, for instance, being far less dangerous than on the face or trunk. It has been remarked also that two or more wounds at distant points are more rapidly effective than when they are inflicted in one spot, owing doubtless to the more rapid diffusion which takes place in the former case.

From a general survey of what is known, it would appear that the poison, in whatever principle it may reside, is one which acts primarily on the nervous system, and also as a septic poison on the tissues with which it is brought in contact; and that in order to produce its effects, it must be directly introduced into the circulation.

In the present state of our knowledge it would be a waste of time to speculate upon the real nature of such poisonous, and, as it would seem, such apparently acrid, properties in a seemingly bland and harmless secretion. Its local effects might be regarded as due to its acting as a septic ferment, analogous to that by which many kinds of blood-poisoning are brought about; but if so, the "venom" would seem to differ from all such ferments with which we are acquainted in the circumstance that its effects vary in intensity directly with its quantity. The minutest possible portion of the variolous poison, or of the septic agent by which scarlatina and other analogous affections are produced, is as efficacious as a larger quantity; and the same may be said also of the septic poison introduced in a dissection-wound, of which the quantity introduced necessary to produce the same amount of local mischief is infinitely smaller than would be required in the case of the serpent's venom. That the effects of a septic ferment should be proportionate, except in a very remote and almost infinitesimal degree, with its quantity, is apparently contrary to all analogy; and at present, therefore, we are hardly justified in looking upon the venom of snakes simply as such a substance, notwithstanding that it possesses some of the properties incidental to it.

It might perhaps be suggested that the "venom" may reside in a principle analogous to, though quite different from, *ptyaline*, and, like that principle, capable of exerting a rapid catalytic action upon some of the constituents of the blood, under the innocent guise of an inert substance.

With respect to the treatment of "envenomed" wounds, and further observations on their nature, all that is necessary will be found under the head "Poisoned Wounds," Vol. I., p. 427.

SURGICAL DISEASES OF CHILDHOOD.

By T. Holmes, Esq., B. E. Brodhurst, Esq., and Alex. Shaw, Esq.

Revised by Samuel Ashhurst, M.D.

The surgery of the diseases of childhood naturally divides itself into three different classes, viz., the pathology and treatment of, 1. Malformations; 2. Injuries and their sequelæ; 3. Diseases. The purport of this essay is not to give a complete account of each of these subjects, inasmuch as many of their topics have been treated elsewhere; but to indicate the matters with which the surgery of childhood is principally concerned; to point out to the reader whereabouts in this work such of those matters as have been included in previous essays may be found; and to give a short account of those which have not been elsewhere treated.[1]

It is a very well-known fact that children will sometimes bear severe accidents or surgical operations without any injury to their general health; while at other times much slighter injuries or operations are followed by very alarming symptoms, and sometimes even by death, although the child does not seem unhealthy, and is not much reduced by disease; so that children are sometimes said to bear operations better than adults, and sometimes the reverse. It is not always easy to explain this discrepancy; but the main principle to be borne in mind in operations on children seems to be this—that children bear the loss of blood, and all other causes of sudden shock, worse than adults; but bear protracted suppuration and long confinement to bed better, and are far less liable to the secondary complications of wounds. Erysipelas in its milder form is not very rare in children's hospitals, where the spreading or ulcerative variety of phagedæna may also be occasionally seen; and the condition usually known as diffuse phlebitis is also met with, though more rarely; but pyæmia, though not unknown, is exceedingly rare; and diffuse cellular inflammation (or phlegmonous erysipelas) is almost, if not quite, unknown.

Our first care in operations on children must be to avoid shock. Hemorrhage is the chief cause of shock, where anæsthetics are used; but when this is not the case, pain, terror, and struggling are also most efficient causes of prostration, and more especially in protracted operations. Even when chloroform is used, a very protracted operation is liable to be followed by prostration—both because long operations generally involve the loss of much blood, and because the prolonged administration of chloroform is itself a very serious cause of depression. I have had no experience of the effect of ether when administered for a long time; but there seems every reason to believe that it would prove equally depressing. But operations in children are often made longer by the necessity which there is for examining the parts under chloroform at the time of the operation, since the child will not permit this to be done without the anæsthetic. In all cases, however, in which it is possible, this examination should be performed a few days previously; and the surgeon should come prepared to begin the operation at once. If the proceeding is of such a nature that the child must necessarily be kept for a long while under the influence of the anæsthetic, it seems a good plan to administer a stimulant a little while before, such as a glass of wine or a little sal-volatile.

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[1] The following list comprises most of the topics in the foregoing pages which relate exclusively to diseases peculiar to, or more usually met with, in childhood: Noma, or cancrum oris, vol. i., p. 356; Trismus nacentium, p. 565; Scrofula, p. 158 et seq; Congenital cutaneous cysts, p. 247; Vascular tumors, p. 271; Burns and scalds, p. 408 et seq.; Separation of epiphyses, p. 482; Incomplete fractures, p. 483; Depressions of the skull, p. 268; Foreign bodies in the ear and nose, pp. 421–423; Burn and scald of the larynx, pp. 698, 699; Foreign bodies in the air-passages, p. 702 et seq.; Laryngotomy and tracheotomy, p. 715; Rupture of the thoracic viscera, without wound, p. 785; Rupture of the urethra, p. 826; Dislocation of the head of the radius, p. 880; Supernumerary auricles, vol. ii., p. 172; Strumous glands, vol. i., p. 170; Orthopædic Surgery, vol. iii., p. 326 et seq.; Diffuse periostitis, p. 126; Scrofulous disease of bone, p. 157; Scrofulous disease of joints, vol. iii., pp. 249, 264; Hip-joint disease, p. 286; Spinal disease, p. 300; Tongue-tie, p. 261; Gumboil, p. 549; Congenital hypertrophy of gums, p. 561; Exanthematous jaw-necrosis, p. 582; Diphtheria and croup, vol. iii., p. 27 et seq.; Enlarged tonsils, vol. ii., p. 494; Cleft palate, p. 501; Nævus of lips and cheeks, p. 517: Congenital cysts of the mouth, vol. ii., p. 522; Congenital malformation of intestines, p. 600; Intussusception, p. 605; Congenital hernia, p. 671 et seq.; Prolapsus of rectum, p. 638; Polypus of rectum, p. 662; Extroversion of bladder, p. 754; Incontinence of urine in children, p. 769; Hypospadias and epispadias, p. 784; Stone, p. 818 et seq.; Congenital malformations of vagina, vol. ii., p. 985; Imperfect development and retention of testis, p. 893 et seq.; Congenital hydrocele, p. 900; Means of strangulation of nævi, vol. iii., p. 666; Harelip, p. 625; Contracted cicatrices, p. 633. Besides these, all affections of the eye, the ear, the skin and its appendages, and the various excisions, will be found in the essays devoted to those subjects.

But even without much bleeding or prolonged suffering, there are some cases of operation in children in which the shock proves fatal without any obvious cause. This is no more than what happens sometimes to very sensitive adults; but it is, perhaps, more frequent in children. Thus, in a case of lithotomy under my care, the bladder was reached without difficulty or hemorrhage; only a slight delay occurred in seizing the stone, on account of its smallness and smoothness; the child was on the table altogether only a few minutes. No bleeding occurred afterwards, except the slight oozing which frequently follows the flow of urine over the surface of the wound. Still, the boy never rallied, and died next day. There was no lesion discoverable on post-mortem examination. Stimulants were given in this case; but perhaps not so freely or so frequently as they should have been. If such a case were to occur again, it would be well to make the child take small quantities of wine and of diffusible stimulants every hour, until a decided change for the better resulted. Of the serious effects which may follow upon the shock, pain, and struggling of an operation, even when there is no hemorrhage, the following example occurred to me. A twin child, a few weeks old, was brought to me for advice as to a congenital tumor of the orbit, which had pushed out and ruptured the globe of the eye. In consequence of the rapid growth of the swelling, life could not be long maintained unless the disease was removed; yet the child was so exceedingly puny, emaciated, and feeble, that it was obvious the least injury might prove fatal, much more so serious a proceeding as removing a tumor which filled the whole orbit, and projected a good deal on to the face. Having placed the risks of the operation fairly before the mother, I proceeded to remove the tumor without administering chloroform. Perhaps this was not the best course which could have been pursued. Very possibly the careful administration of a small quantity of the anæsthetic, sufficient to dull the sense of pain without producing more profound anæsthesia, might have saved the child from the consequences which did ensue. The operation was finished without much blood having been lost; but then the child passed into an alarming state of syncope. Restoratives were at hand; and when by stimulation with ammonia, wet sponges dashed on to the face and throat, and artificial respiration, the powers of swallowing had been regained, a little wine and brandy could be given, and the child seemed restored to life. But she soon relapsed, and appeared again to be dead; in fact, was pronounced dead by some of those who were standing about. Artificial respiration revived her for the time; then the galvanic battery was brought into play, and applied to the chest with marked benefit; stimulants being also constantly administered. But for three-quarters of an hour the child's life was in the most extreme danger; and as soon as the galvanism was suspended, syncope recurred. At the end of that period, she recovered permanently from this alarming condition.

This mention of the grave symptoms which may follow upon the pain and shock of an operation naturally introduces the consideration of the administration of anæsthetics in childhood. No department of surgery has profited more by the discovery of anæsthetics than that which is concerned with children's diseases. It is very frequently quite impossible to examine a diseased joint satisfactorily and thoroughly, to sound for stone, or to perform any other examination which either lasts long and produces pain, or which requires quiet and silence, without rendering the child unconscious. Hence the administration of ether and chloroform is of daily occurrence in our children's hospitals: and the very great rarity of accidents from such administration shows that in all essential particulars chloroform (which is the anæsthetic usually employed) is as safe as it is certainly efficient. But chloroform often causes unpleasant, and sometimes even alarming, symptoms; and although I have not yet had the misfortune to witness a fatal result, I saw one case in which the patient was only revived by a vigorous application of restorative measures from a condition of apparent death. The unpleasant symptoms referred to are chiefly the rapid fluctuations of pulse, and the tendency to sudden congestion and stertor. If these threatening symptoms be overlooked, and chloroform still given, the pulse and respiration may be suddenly suspended, and alarming or even fatal symptoms ensue. So that it is always necessary to watch the pulse closely, and to give chloroform with great caution in children, even when they breathe it quietly; and still more when, from their struggling and crying, the anæsthetic is taken in irregular and often very full doses. Usually after such struggles the child passes almost at once into an insensible condition; and, as soon as this occurs, the chloroform should be administered only to such an extent as to prevent struggling. Both children and grown people when under chloroform will give indications of pain, while the real feeling of pain (at least if tested by the patient's remembrance of the operation) is quite absent. It is, therefore, not necessary for the comfort of the patient that every movement and every sound indicative of pain should be suppressed.

When asphyxia comes on, prompt measures will almost always save the patient. The tongue should be at once pulled as far as possible out of the mouth with a pair of forceps, and artificial respiration should be resorted to. Whatever difference of opinion may exist as to the most effectual method of performing artificial respiration in other cases, I should think that a very little experience would convince any one that in those at least of asphyxia from chloroform in childhood, the most natural and simple method is also the best, viz., by manipulation of the ribs. The small size and yielding material of the chest-walls in childhood enable us to manipulate the lungs through them almost as easily as if they were uncovered. Dr. Marshall Hall's method (if it is ever more effectual than manipulation) is certainly inapplicable in these cases, since it endangers the flow of substances from the stomach into the larynx, and interferes with other restorative measures which may do good, but which cannot be allowed to supersede artificial respiration.

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MALFORMATIONS.

TABLE OF MALFORMATIONS.

I. Of the whole body, or general. Double monsters; attached fœtal remains.
II. Of the head and face. 1. Of the mouth: congenital fissure; harelip; fissured palate.[1]
congenital closure or atresia oris; microstoma congenitum.
2. Of the nose: congenital absence.
" fissure.
3. Of the eye:[2] " defects of iris.
" cataract.
" closure of the lids.
4. Of the head:[3] cephalæmatoma, congenital tumors; meningo- and encephalo-cele.
Of the spine. Spina bifida; congenital tumors.
III. Of the neck. Congenital closure of the œsophagus; congenital stricture.[4]
IV. Of the thorax. " fissure of the bones; malformation of heart.[4]
V. Of the abdomen, etc. Congenital defect of parietes;[4] malformation of viscera;[4] imperforate rectum; congenital hernia;[5] undescended and retained testis.[6]
Congenital adhesion and imperforation of vagina.[7]
Hypo- and epi-spadias; extroversion of the bladder.[8]
Hermaphroditism. Congenital defects of the pelvis.[4]
Imperforation of the urethra.
VI. Of the limbs. Deficiency of bones and limbs;[4] supernumerary fingers and toes; webbed fingers and toes; congenital dislocations; fracture and amputation in utero.

Attached Fœtus.

In very rare instances twins become attached in the womb, and are born thus into the world; and this in two different conditions, viz., either as two living individuals united at some part of their bodies, or one fœtus is only imperfectly developed, and in this imperfect condition is attached to the other as a parasite.

Of the first condition the Siamese twins and the Hungarian sisters are the best known examples. The only purely surgical question which occurs with reference to the treatment of such cases of monstrosity is as to the expediency of dividing the connecting ligament, and setting them free from what is not merely a restraint but also a grave danger, since the death of one twin must necessarily involve that of the other. In a work like the present it would be absurd to waste space upon such curiosities of surgical practice, in the treatment of which the surgeon would be bound to have recourse to the authorities specially devoted to the subject.[1] It may, however, be stated in general terms that when important parts (such as the anus) are common to the twins, the operation is impossible; that when the connection is in or near the buttock, a communication may fairly be supposed to exist between the spinal columns, which would render any operation fatal; but that when the connection is sideways, and the band of moderate thickness and extent, the operation ought to be attempted, and has been performed with success;[2]

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[1] Treated of above, see Vol. II., p. 501; Vol. III., p. 572.

[2] Treated in the essay on DISEASES OF THE EYE, Vol. II.

[3] Treated of in the essay on REGIONAL SURGERY.

[4] Nothing is said about these malformations here, since they do not admit of surgical treatment.

[5] See the essay on HERNIA.

[6] See the essay on DISEASES OF THE MALE ORGANS.

[7] See the essay on DISEASES OF WOMEN.

[8] See the essay on DISEASES OF THE URINARY ORGANS.

[1] Amongst which may be specially mentioned Dr. W. Braune's work entitled Die Doppelbildungen und angebornen Geschwülste der Kreuzbeingegend, where all the cases of twins attached in the sacral region are given.

[2] The case in which adhering twins were successfully separated is related by König in the Ephem. Germanicæ (nat. cur.), 1690, vol. viii., dec. ii., obs. 145.

A drawing is given of them united by a band, which is described as stretching from the ensiform cartilage to the umbilicus, and as being an inch broad, one and a half inches deep, and five inches long. The umbilical cord was single, and contained four arteries and two veins. Its lower part was attached to the band, and it seems doubtful whether the band was really anything more than a also that if one twin die before the other, an attempt might be made to cut the dead one away.[1]

The second class of joined twins—viz., that in which one of the twins is only slightly developed, and included in the living twin as a parasitic growth—is of considerably more importance in surgery than the former, since both the diagnosis and the treatment become occasionally matters of considerable doubt and difficulty. I shall consider these cases under the natural division of attached parasites and included parasites; but we must not forget that this division, however natural, is not to be trusted in practice, since a great part of the attached parasite may be included. However, the difference is so striking between those cases in which large parts of the parasitic fœtus (usually terminating in more or less rudimentary extremities) hang pendulous from the principal organism, and those in which the parasitic remains form a mere tumor which may not even be prominent under the skin, that the distinction will always be made.

No difficulty of diagnosis can exist in the case of the attached parasite. The advantages and feasibility of removing it from the body to which it is appended will depend in a great measure upon the place and extent of its attachment, and partly upon the nature of the parasite itself. If a large part of the imperfect twin is attached in the near neighborhood of vital organs, as in the case of the Asiatic, whose cast is in so many museums, having a large part of the body and both extremities of another fœtus hanging from his thorax, much care would be required in attempting the removal of the parasitic growth. Still there would, I should suppose, be no insuperable difficulty in amputating at any rate so much of it as would restore the person to a natural appearance when clothed. A clamp might be fixed tightly on the neck of the tumor, or large vessels might be discovered and tied before the operation, or the pedicle might be severed by gradual strokes of the knife and the vessels tied as they were divided, or finally the question of piecemeal amputation at several sittings might be entertained.[1]

The removal of such parasites, when they occupy (as they far more often do) the pelvic region, is very necessary to the patient's comfort; but here, before their removal is decided on, the question of their nature and connections must be very carefully considered. In those cases of double monsters (like the Hungarian sisters) where the twins are attached by a broad band near the buttocks, it has always been found that either the rectum, genitals, or lower end of the spinal column, or all these parts, were common to both bodies; and therefore that the twins

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fusion of the two cords. A ligature was put upon it first, and then it was divided with a knife. The separation, he says, was effected "ligaturâ prægressâ indies strictiori, dein cultelli scissurâ" Mr. Startin proposed a similar plan for the separation of the Siamese twins, by surrounding the connecting band with a metallic girdle, formed of two parts sliding on each other, and hooped together by pegs or notches. One of these notches being drawn in every day the girdle would be imperceptibly tightened, till merely a thin band of skin would remain, which could be severed without any risk. (Brit. Med. Journal, Feb. 20, 1869.)

[[1] A very full and accurate account of the anatomical relations of Chang and Eng, known as the Siamese twins, prepared by Professor Harrison Allen, will be found in the Transactions of the College of Physicians of Philadelphia, third series, vol. i. The band of union consisted of the ensiform cartilages connected by firm ligaments; of peritoneal extensions from both bodies, overlapping each other, but not connected; a band of liver-tissue; a small and unimportant artery, and cutaneous structures.

The propriety of attempting a separation in the case of the twins is considered by Professor W. H. Pancoast in the same volume. With the knowledge of the overlapping peritoneal pouches, and the connecting band of liver-tissue shown by the autopsy to exist, Dr. Pancoast's conclusions do not materially differ from those arrived at in the text by Mr. Holmes.]

[1] Since the above was written, I have been informed by Dr. Pancoast, jun., of Philadelphia, of a case in which his father has successfully removed with the écraseur an attached parasite from the facial region. The photographs of the child before and after the operation are in the Museum of St. Bartholomew's Hospital. This operation seems to have been done in early infancy; and it would probably be in most cases advisable to make the attempt as soon as possible. More than ordinary complications in the operation, or unusual weakness in the infant, might induce the surgeon to wait for a time. The photographs referred to show that the parasitic fœtus was attached to one cheek of the living child, that the body was provided with rudimentary extremities, and ended in a large fibro-fatty mass; and that on cutting it open many of the parts of the natural body could be distinctly traced in it, especially the gastro-intestinal tract. The only harm that was occasioned by its removal appears to have been that a fistula into the mouth of the infant was left in consequence of the buccinator muscle having been prolonged into the coverings of the parasitic fœtus, and having been injured in its removal. It is very much to be wished that further particulars of this remarkable case should be published.

could not be separated without fatal consequences. But when the deformity is that which is commonly called "the human tripod," in which the two legs of another fœtus, blended together into one, are attached to the pelvis, no such connection is probable. The genitals of the parasitic fœtus as well as the spinal column are probably absent; and if they were developed, it would still be possible in many cases to remove the projecting extremities. In cases of tripodism, therefore, amputation should be practised, especially on males, in whom the defect could only be concealed from view by condemning them to wear female clothing. All the published cases of this deformity will be found collected in the work of Braune, Die Doppelbildungen, etc. I would especially call attention to the case (mentioned in that work on p. 20) of Anna M. Przesomyl, a Bohemian. She was shown, at six years of age, to the Gesellsch. d. Naturforscher in Prague, and had then an irregular oval swelling, covered by the normal skin, hanging from the buttock by a pedicle, so that it struck against the legs when she walked. The skin was healthy, except over the pedicle, where it was thin, and almost like mucous membrane. Bodies resembling long bones could be felt in the tumor, and there were "evident traces" of fingers or toes projecting from its lower part. Fœtus in fœtu was universally diagnosed. As no evidence could be obtained of the extent of the tumor inside, or of the nature of the connection with the pelvic organs or spine, the operation was declined. The child was then taken about as a show, and seen by all the anatomists and surgeons in Germany, Holland, Sweden and Denmark. Dieffenbach wanted to remove the parasitic growth; but the father would not consent on account of the gain which he made by showing the child. The parasite grew; but her health continued quite good. At sixteen she determined to have it removed (although she could walk quite upright, and had perfect health), so much did she suffer from the weight of the parasite. Its shape, size, etc., are shown in an engraving in Braune's work. The length was about 26 inches; the weight was guessed at about 20 pounds; the pedicle, which passed into a kind of niche in the buttock, was about as thick as the forearm.[1] It was successfully amputated through its first swollen portion, leaving a considerable stump; but this stump, which would never heal, was accidentally attacked with gangrene in consequence of a fall, and was then successfully removed by ligature and sawing through its bony connections. In the end the girl seems to have been quite cured.[1]

I need not dwell here on the cases of included parasites (*i. e.*, fœtal remains forming a tumor, either subcutaneous or in one of the great cavities or viscera), since such cases must be treated on the same rules as any other innocent tumor. It is, in fact, only when the parasite is near the surface, and lies in a situation in which such growths are often met with, as the sacral or coccygeal region, that the nature of the affection can be even suspected before operation. The general rule of surgery must be borne in mind, that when a tumor threatens life, it is justifiable to run any risk for its removal; but that in operations of complaisance, as those are termed which are performed on account of affections not incompatible with bodily health, no danger ought to be incurred, except at the express wish of the patient, or his friends, if a child, after the nature of the case has been properly explained.

Congenital sacral tumors.—In connection with these cases of included fœtus and attached fœtus we must also speak of those rare cases in which congenital tumors are found in the sacral region, which have no distinct marks of parasitic origin. Such are the cystic, fibroid, and fatty congenital tumors.

These tumors it is important on many grounds to distinguish from the included and attached parasites. They are divided by Braune into three categories: 1, coccygeal tumors, which are compound cystic, and other congenital and more or less solid tumors of the region; 2, simple cysts; 3, caudal excrescences and lipomata. The first class are of various composition, and grow more or less rapidly. They are intimately connected to the sacrum and to the coccyx, when that bone is developed; and they very frequently are in connection with the spinal membranes. When the spinal canal, however, is closed, they usually spring from the interior of the pelvis, and press the coccyx backwards. The anus is displaced forwards, and the growth is, according to Braune, always limited by the edge of the gluteus maximus muscle. Operative interference with such tumors is in the highest degree dangerous, and should by all means be avoided if possible,[2] though the occurrence of convulsions or other symptoms dangerous to life may induce the surgeon in rare instances to interfere. Such was the case in the only tumor of this kind which I have myself seen. It was in appearance a simple fatty tumor, but was connected with the interior of the spinal canal, and had caused convulsions. It was extirpated with success by Mr. Athol Johnstone, whom I assisted in the operation. We both saw distinctly the bulging and pulsation of the spinal membranes after the removal of the tumor. The child died of another disease some months afterwards; and the nature of the tumor was proved by dissection.[1]

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[1] Prag. Vierteljahrsschrift, 1850, vol. xxv., p. 74.

[1] Other instances of the successful removal of these superfluous limbs will be found in my work on the Surgical Treatment of Children's Diseases, 2d edition, pp. 11, 12.

[2] Braune gives reference to 46 cases, in 16 of which operative measures were attempted; but in only 5 with success. In all 5 extirpa-

The other descriptions of congenital sacral tumor, viz., the cystic and the caudal or lipomatous, are apparently somewhat less dangerous, especially the former, although none of these tumors can be operated on without risk.

The main points in the consideration of these rare affections are to distinguish if possible between the congenital tumor and the parasite, and to determine in the case of either of them whether there is any connection with the interior of the spinal canal or with the pelvic viscera. The distinction between the parasites which do not show characteristic shapes (as those do, for instance, which terminate in fingers and toes) and the tumors is by no means easy. Even after removal from the body, it is not always possible to be confident as to those which contain a number of cysts mixed with various tissues, such as shapeless masses of cartilage and bone, whether those tissues are parts of an undeveloped fœtus or mere accidental formations.[2]

I published a short time since the account of a very large congenital tumor, of the compound cystic variety, projecting in the left buttock, and attached near the coccyx, which I removed successfully from a female child, three years of age. The tumor was so intimately connected with the lower bowel that it had an impulse on coughing just like a hernia. The contents of the large cyst were fluid, resembling cream in color, but very fetid. At its base were some smaller cysts, but no distinct traces of any fœtal structure.[3] A somewhat similar case, under the care of M. Stoltz, of Strasbourg, appears to have been of the dermoid variety.[1] Numerous other instances of the successful extirpation of these congenital sacral tumors have been put on record.

In congenital sacral tumor, whether from fœtal inclusion or not, the question of surgical interference depends not on the origin but on the connections of the tumor; that is to say, that there are fœtal tumors which may be removed with perfect success, while there may be other tumors, not fœtal, in which the formation may be so far within the pelvis as to be inaccessible to the knife. Another point is, I think, equally clear from the records of the treatment of such cases, viz., that the total removal of the tumor is a safer course, if surgical interference is admissible at all, than any partial operation.

Thus in a well-known case under his care, Sir B. Brodie says: "Contrary to my advice, a surgeon made an incision into the tumor, which not only served no useful purpose, but left him in a worse state than he was before. Different cysts suppurated, discharging pus and adhesive fluid; sometimes a collection of fluid and pus pressed on the rectum, occasioning a difficulty of expulsion of fæces, and then discharging its contents into the bowel. After this he was always in a state of greater or less suffering. He lost flesh, had occasional attacks of fever, and at last he sank and died."—Path. Soc. Trans., vol. iii., p. 447.

In fact, it is difficult to see what useful purpose is to be served by these partial proceedings. Either the tumor is within reach of dissection, or it is not. If it be, and if the operation be undertaken in childhood, and the operator succeed in removing the tumor entire, there is hardly an instance on record in which the operation failed of success in uncomplicated cases. But suppose, on the other hand, that the tumor passes so deeply into the pelvis as to be beyond the reach of the knife; what prospect is there then that even a child, far less an adult, could survive the diffuse cellular inflammation, the consequent abscess in contact with the pelvic peritoneum, and the possible visceral complications which would follow from laying open such a cyst with a view to its obliteration by granulations, or from passing a seton through it, or from injecting it with an irritating fluid? I think it undeniable that in any doubtful case the more prudent course would be to endeavor to remove the tumor; and if this turns out to be impossible, then as a *pis-aller* to remove as much of it as possible, and

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tion was the method adopted, which is much preferable to ligature or puncture. The subdivisions which Dr. Braune makes of this class of tumors are not necessary for our purpose.

[1] Path. Soc. Trans., vol. viii., pp. 16–28.

[2] This remark is illustrated by a preparation in St. George's Hospital Museum, consisting of a number of irregular pieces of bone from a congenital tumor removed by Sir B. Brodie from the sacral region. The operation proved fatal.

[3] Surgical Treatment of Children's Diseases, p. 14.

[1] See the French translation of the above work by Dr. Larcher, p. 17.

leave the remaining cavity to granulate up. I speak of it as a cavity because these tumors are generally more or less cystic; and I should suppose that the prolongation of a solid tumor deep into the body could be ascertained before operation.

The question, then, resolves itself into discovering the connections of the tumor as far as possible—whether it communicates with the spinal canal, with the rectum or bladder, or passes up so far into the pelvis as to be inaccessible. The diagnosis must be allowed to be sometimes very difficult. If the tumor, as in my case, be situated quite to one side of the middle line, the idea of its spinal origin may be laid aside; but in all doubtful cases the nature of the fluid contained in the sac should be very carefully ascertained by puncture and subsequent chemical observation. The communication with the spinal canal is often so small as to escape detection by physical examination; so that if a tumor lying in or near the middle line contains fluid resembling that of spina bifida, it must be regarded as of spinal origin; and no attempt should be made to extirpate it.

The communication of a tumor of this kind with the rectum can be judged of by the occasional discharge of its contents in the motions. Whether this fact precludes the possibility of successful removal, is a question for the surgeon carefully to weigh. It is, to say the least, an obstacle to operation. Communication with the other pelvic viscera, as the bladder or vagina, is no doubt possible; but I do not know of an instance.

The depth to which the tumor extends in the pelvis can only be imperfectly determined before operation. On the one hand, my case shows that even a very distinct impulse may be present without the tumor being in contact with the abdominal portion of the intestines, or penetrating into the general peritoneal cavity; while a case reported by Senftleben[1] on the other, proves that the peritoneum may be opened in operating on a case where no such impulse has been noted, though it proves at the same time that such an accident is not necessarily fatal.

In the Brit. Med. Journ., March 23, 1867, I have collected the results of all the cases of congenital sacral tumor, which are reported by Braune, where operations were practised, with the addition of Corradi's,[2] Senftleben's, and Jollye's[3] cases, which were published since the date of Braune's work, and all of which were successful.

The following are the main results: 1. As to congenital tumors not of a fœtal nature, including all forms of tumor, both solid and cystic, extirpation was carried out in nineteen cases reported by Braune, though in some of them it seems not to have been complete.

Four of these tumors communicated with the spinal canal. In the two cases where the surgeon was able to remove the whole tumor, the operation succeeded; the tumor being in both cases fatty. In the two other cases the tumor (more or less cystic) was only partially removed, and death followed.

In five cases, where the tumor was pendulous and more or less solid ("caudal lipomata," Braune), extirpation was complete, and successful in all.

This leaves ten cases of tumors, chiefly cystic, unconnected with the spinal canal, and attached to the sacrum or coccyx. Extirpation was only partial in two cases; in one of which the result was fatal, in the other doubtful. In the other eight cases the removal seems to have been complete, and all the patients recovered except one. To these Mr. Jollye's case is to be added.

The other methods of treatment, less radical and in appearance less formidable, show nevertheless a result in striking contrast to the great success of removal. Under the head of simple "incision," or "puncture," are contained the records of four cases of "coccygeal tumor," and five of "sacral hygromata." All were fatal. But in another case of sacral hygroma, puncture followed by iodine injection was effectual in curing the disease. The ligature was used in three cases of "coccygeal tumor," and in two cases of sacral hygroma; the two latter cases were cured, the three former were all fatal; but it is fair to note that in two of them it seems as if the complete extirpation of the tumor was contemplated, but was found impossible, owing to its extensive connections, the disease being of a malignant nature. Here the ligature seems to have been employed only as a last resource, probably to save the patient from bleeding to death.

The inference from this is inevitable, that in all those cases of congenital sacral or coccygeal tumor in which it appears desirable to interfere at all, the complete removal of the tumor, either by the knife or the ligature, should be the aim of the surgeon, and that it is in reality far more safe to dissect out the tumor than to pass a ligature beneath it. In a case where the tumor spreads so far into the pelvis that it cannot be followed with the knife, the ligature perhaps must be used, but it can hardly succeed in curing or even checking the progress of the disease.

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[1] Deutsche Klinik, 1865, p. 174.

[2] Ann. univer. di Med., for 1866, vol. cxcv., p. 423.

[3] Lancet, Aug. 4, 1866.

Punctures (except for purposes of exploration), incisions, and setons, ought to be absolutely rejected; nor would I advocate the employment of iodine injection in any case that seemed at all suitable for removal.

Next with reference to tumors of fœtal origin. After laying down the natural division of these fœtal tumors into "supernumerary limbs" and "parasite-tumors," and calling attention to the insufficiency of minor operations, Dr. Braune says: "Either amputation or extirpation, whether with the knife, ligature, or écraseur, must always be the operation undertaken. In case of supernumerary limbs, flaps are formed, and the proceeding more resembles an amputation, while in the parasite-tumors it is more of the character of extirpation. Where the tumor is pedunculated, pendulous, or with a bony attachment and very vascular, the écraseur may be used with advantage, or Middeldorpff's galvano-caustic, which more than replaces the old ligature and annular application of the cautery.

"Incision into the fluctuating swelling was practised twice, and was followed in both cases by death. In one, injury of the spinal membranes was the cause, the tumor being of the nature of spina bifida.

"The bony stalk was sawn through, and its upper part left in the pelvis in three cases, and in all with success.

"Extirpation was practised eleven times, ten times with success, in the other with a fatal result, spina bifida being also present.

"The ligature was used three times, twice successfully; once it had to be taken off again on account of convulsions."

The three amputations referred to above were—1. By Pitha, quoted above, p. vi. 2. By Geller (Virchow's Arch. VI., 520), of a tumor terminating in a finger and of very large size, which was removed at the age of eight weeks. 3. By Schuh (Wien. Med. Wochensch., 1855, No. 51), of a large tumor containing portions of intestine, nerves, and numerous pieces of bone, and attached to the sacrum by a bony pedicle.

To these instances of amputation of supernumerary limbs, I may add Dr. Corradi's case, in the Annali Universali, for 1866.

The successful cases of extirpation of a sacral tumor with fœtal remains belong to the following surgeons: Jacob of Dublin, Otto, Middeldorpff, T. Blizard, Schwartz, Laugier, Porta, Lotzbeck, Emmerich, and Osiander. For the references, I must refer to Dr. Braune's work.

To these instances of successful extirpation, Senftleben's case, above quoted, is to be added; making the number of successful operations eleven, against one failure.

The total result of this series of operations would be, that we have two instances of successful amputation of well-marked and large-sized supernumerary limbs, two of amputation of tumors of fœtal character and attached to the pelvis by a stalk, and twelve of extirpation of tumors of a fœtal nature apparently not so attached, and that in all the cases, except one of the last named, the operation succeeded; while in the fatal case the disease was complicated with spina bifida.

I think, then, that the evidence which I have here produced (and which includes, though perhaps not the whole, certainly the great bulk of the published cases) is very favorable to operative interference in these distressing deformities. The results of experience also confirm the conclusions of *à priori* reasoning, in showing that when operative measures are necessary, total removal is the proceeding that should be adopted. In the great majority of cases, I think that the knife will be found safer than the écraseur, and *à fortiori* than the ligature.

It appears more prudent, both in cases of subcutaneous parasitic formations and in compound tumors, not to be too anxious to extirpate the entire growth. If the projecting portion which is interfering with the patient's comfort be removed, that is all that may be necessary. A too-deep dissection may easily produce fatal mischief. It does not seem that supernumerary limbs, if amputated, ever grow from their base; and in the case of tumors, though they may certainly grow again, the risk of having to perform a second operation seems to be, on the whole, the less evil of the two. The simple cyst must, however, of course be extirpated entire, if at all.

Congenital malformations of the face are not limited to harelip and fissured palate exclusively, although those malformations form so much the larger part of the whole, that a man may have had an extensive experience in the treatment of them without ever having had an opportunity of seeing the rarer forms.

A condition of the mouth is spoken of similar to that which so often affects the anus, viz., congenital imperforation—atresia oris. It does not seem, however, that any instance is related as having occurred within modern times. The treatment would consist in removing the membrane which closed the mouth, and attempting to unite the skin to the mucous membrane around the opening, so as to promote union by the first intention, without which a recurrence of contraction would be to be feared.

The congenital smallness of the mouth (microstoma congenitum) spoken of by Von Ammon and Dieffenbach[1], appears to be merely a phenomenon of deficiency in the development of the lower jaw, and therefore to be beyond treatment.

A fissure similar to the common harelip is said[2] to have been occasionally noticed in the lower lip; and another similar deformity is that which extends laterally from the angle of the mouth, so as to expose the back teeth.[3]

Fissures into the nostril through the substance of the cheek are also met with in a few instances.

All such deformities must be treated on the same general principles of plastic surgery which guide us in operations for harelip; viz., to close the opening by drawing over it the soft parts with their raw edges in as neat apposition as possible, and with as little tension as may be. Any adhesions to the bones of the face which render this difficult must be divided. If the cleft be very large, it may be necessary to cut free a flap to glide over and fill it; and in all cases in which the muscles tend to drag on the wound, their action should be neutralized by the "harelip suture."

Congenital absence of the nose has been spoken of, the feature being replaced by two mere openings on the surface of the face; and an operation has been described, which is said to have cured this horrible deformity.[4] It is not, however, very clearly described, nor does the case seem to have been satisfactorily followed up. It is difficult to understand how a prominent feature could be fashioned out of the soft parts, if the nasal bones were wholly absent. In such a case Langenbeck's operation for transplanting the periosteum of the frontal bone might possibly be of service.

The congenital defects of the organs of vision have been spoken of in Vol. II. (DISEASES OF THE EYE.)

The malformations of the brain and its coverings, which give rise to the tumors of the skull named meningocele, and encephalocele, will be found described with the other tumors of the same region in the essay on REGIONAL SURGERY.

The next congenital affection which should engage our attention is *spina bifida*. This is a malformation which is seen, perhaps, more frequently than any other except harelip. It may be defined as a congenital hernia of the spinal membranes through a fissure in the walls of the canal. Thus a tumor is formed, which is usually of a rounded shape, lying in the middle line of the back, fluctuating, often semi-transparent, adhering to the bones of the column either directly or by means of a pedicle.

Anatomy.—I shall not attempt in this place to describe the anatomy of the rarer forms of spina bifida, some of which, such as complete fissure of the whole spine, are incompatible with life, and therefore of no practical interest; while others, such as the multilocular tumors, those which are complicated with complete absence of vertebræ, those which arise from fissure of the body instead of the laminæ, etc., are so rarely met with that each case would require a separate description. Excluding these rarer forms, let us study the surgical anatomy of spina bifida, in the same manner as that of other herniæ, by describing the composition of (1) the coverings, (2) the sac and its neck, (3) the contents.

1. The tumor is in most cases covered by healthy and unaltered skin; frequently, however, the skin is variously modified from the standard of health. Cases are recorded in which the density of the skin was increased, so that it is described as hard and coriaceous;[1] but it is far more common to find the skin thinned or even altogether deficient. This is due to one of two causes; either the skin was originally properly formed, with the cutis and epidermis natural, but has become thinned as the tumor increased, or the skin has been congenitally deficient, being represented only by a thin fibrous material (something like a cicatrix) covering the spinal membranes, or even altogether absent, so that a bluish-red membrane permeated by vessels is exposed, which is the spinal dura mater. In some of these cases it is said that the latter membrane also has been absent, and the arachnoid exposed. When the coverings of the tumor are thin, serum may ooze through them without any actual hole;[2] but ulceration very soon takes place as the tumor increases, and then the sac bursts.

2. The sac of a spina bifida is formed of

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[1] Fritze u. Reich, Plastische Chir., p. 90.

[2] Nélaton, Path. Chir., vol. ii., p. 699.

[3] Von Ammon, Angeborne Chir. Krankht, tab. iv., p. 14; Debout, Bull. de Thér., vol. lxiii., p. 15. Sir W. Fergusson, in his lectures at the Royal College of Surgeons, exhibited drawings of each of these malformations (Lancet, June 25, 1864); and drawings of all these malformations of the face have been inserted by Dr. Larcher in his translation of my work on the Surgical Treatment of Children's Diseases. (See fig. 879, p. 630.)

[4] Maisonneuve, in Bull. de Thér., 1855, vol. xlix., p. 559.

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[1] Case iv. in Mr. Prescott Hewett's paper, Med. Gaz., vol. xxxiv., p. 460.

[2] Laborie, Ann. de Chir., vol. xiv., p. 272.

the membranes of the cord matted together; and, in some rare cases where extensive malformation is connected with hydrocephalus, this sac is lined by the substance of the cord itself, spread out into a thin layer on the inside of the membranes. Its neck is formed by an opening in the laminæ and spinous processes of one or more vertebræ, and is longer or shorter according to circumstances. When the hole in the canal is large and the tumor sessile, there seems to be no neck; while at other times the tumor hangs down over the child's back by a long stalk, which in one case is said to have been a foot in length.[1]

3. The contents of the sac are, *first*, in all cases more or less watery fluid—the subarachnoid fluid; *second*, in most instances a portion of the cord itself, or the cauda equina, or some of the spinal nerves; and *lastly*, in very rare cases more or less of connective tissue, or of fat. Spina bifida is caused either by an arrest of development in the arches, or by a dropsy, probably inflammatory, of the membranes before the bones are ossified. Either cause would account for the fact, that the malformation is far more common in the lumbo-sacral region than in all other parts of the spine put together. There are too few preparations of spina bifida in the higher parts of the column preserved, or accurately described, to allow of an opinion as to their usual contents; but it is known that in the common position of spina bifida, the cord, or some important part of it, is almost always contained in the sac.[2] When the cord itself, or its prolongation, is the part contained, it is always closely united to the back of the sac in the middle line. The nerves either run across the cavity of the sac, or in the substance of its tissues, to their destination.

Symptoms.—The symptoms of spina bifida will be easily understood when its anatomy is known. The tumor is always in the middle line, and always attached to the bones. The hole in the canal can be readily felt if the parts which cover it are not very thick. If the skin is thin, the tumor has the transparency of hydrocele. The fluid can often be partly pressed back into the canal, and then tension of the fontanelle, or increase in the size of the hydrocephalus (if the latter exists), will be noticed; nervous symptoms also are frequently produced. The size or tension of the tumor is sometimes increased when the child cries. Symptoms due to interference with the functions of the cord are not infrequent—palsy of the limbs or of the sphincters, and convulsions.

The progress of the disease is usually to death. As the size of the tumor increases, the patient often dies of convulsions, or the skin ulcerates and the tumor bursts; and then palsy or convulsions produce death. But although the great majority of cases are speedily fatal, it is not always so. Many cases are recorded in which the tumor has continued to grow, but not more than in proportion to the rest of the body, and has produced no symptoms—the patient dying at various periods of some other disease.[1] In other and much rarer cases, the disease has undergone a process of spontaneous cure; the elongation of the pedicle produced by the weight of the tumor having resulted in closure of the orifice of communication with the spinal canal, so that there remained merely a closed cyst, which either remained innocuous or was removed. Finally, recovery has been known to follow on the rupture of the sac.

Active surgical treatment usually hastens death; yet cases have been known to recover after many varieties of operation. It is this fact which makes the interest of the disease, and renders the surgeon anxious to separate from each other the cases which should be left alone and those which should be treated actively; and, further, to assign to each class of the latter cases its appropriate method of treatment.

Treatment.—The great obstacles to the success of operations for spina bifida are the free communication between the sac and the cavity of the theca, and the probable presence of the cord, or large nerves, in the sac. In consequence of these anatomical dispositions, every active surgical measure is liable to be followed (in fact, will almost certainly be followed) by diffuse inflammation of the spinal membranes, or gangrenous softening of the cord. Now, as every true spina bifida communicates freely with the spinal theca, and as a very large majority of those of the common form (in the lumbo-sacral region) contain the cord or nerves, no further argument is required to prove the expediency of abstaining from active interference. Therefore, in every case of spina bifida in which the child is in good health and the skin does not threaten to burst, nothing should be done, except to support the tumor by means of a concave shield well padded (which may make slight pressure if no pain is produced thereby), and watch the case, in the hope that the disease may remain stationary—perhaps even undergo a spontaneous cure. But what course is to be pursued in cases where the tumor is increasing rapidly, and where the thinness or ulceration of the skin proves that the sac will soon burst; or where it has once burst and the infant has survived; or where convulsions have come on and are frequent and severe; or where hopeless paralysis renders life a burden? It is obvious that in any of these cases the child's condition can hardly be made worse; and the only question is, whether there is enough prospect of doing good to induce the surgeon to risk the reputation of himself and his art by attempting anything. Let us recur to our previous statement of the chief obstacles to success, and see whether they can be in any way obviated. The first of these obstacles is, the free communication of the sac with the cavity of the spinal membranes. If, then, this communication could be temporarily obstructed, the interior of the sac might be treated by injection, as congenital hydrocele sometimes is, without any propagation of the inflammation to the general cavity; or might, perhaps, tolerate some of the other methods of treatment to be alluded to presently. In other words, pedunculated tumors are much more favorable for treatment than those that are sessile. Next, as to the presence of the cord. If it be present, it is united to the back of the sac in the middle line, and cannot be reduced or got rid of in any way. The injection of iodine would most likely set up such an amount of inflammation as would lead to paraplegia;[1] while ligature or any sanguinary operation must be inevitably fatal. To judge whether the cord is or is not present, we have only probabilities to guide us. The probability of the presence of the cord or large nerves varies according to whether the tumor is pedunculated or not. If the opening into the canal be very small (especially with a voluminous tumor), the cord is the less likely to pass through it, and *vice versâ*. If the tumor can be tapped, and the fluid drawn off without producing nervous symptoms—if there is no increased sensibility in the usual place of attachment of the cord—if the disease, though increasing, is not attended by convulsions—if the tumor is equable in transparency and consistence throughout—if, on tapping the tumor, the trocar can be passed into the centre of the sac without appearing to set up such symptoms as we should expect from touching the cord—we may fairly act on the assumption that the cord is absent. In cases where it is suspected that the cord is present, no treatment should be adopted, except in express deference to the wishes of the child's parents, and with a full knowledge on their part of the probability of a fatal result.

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[1] Boston Med. and Surg. Journ., 1862, p. 456.

[2] Mr. Hewett found only one such preparation out of twenty in which the nerves were not connected with the sac, op. cit., p. 461. The cord has been found in the sac in the dorsal region, Laborie, op. cit., p. 280.

[1] The most advanced age to which any patient has been known to survive seems to be fifty; Behrend, in Journ. f. Kinderkrankheiten, vol. xxxi., p. 350. A curious case is on record in the Bull. de la. Soc. de Chir., 1860, p. 396, of a man who lived to the age of forty-three, having survived a very complicated operation for the stone, and died of a recurrence of the latter disease.

When the rapid increase in the size of the tumor is the only symptom requiring surgical interference, no more active measures should be employed, until the effect of repeated tapping, followed by the application of pressure cautiously and gradually, has been ascertained. In this way Sir A. Cooper obtained two very gratifying successes.[1] The tapping should be performed with a fine trocar, introduced always on one side (remembering that the cord, when it is present, is always attached in the middle line), and the tumor should not be entirely emptied at first. After a portion of its fluid has been removed, a pad and bandage, or some apparatus in the form of a bag-truss, may be used; or the skin may be painted with collodion, either without puncture or after puncture, the wound having been allowed to heal. If the skin is very thin, the collodion should be used at first diluted with equal parts of castor oil. A thick layer should be painted on, and the part kept exposed to the air till the fluid has completely dried (say an hour and a half). In a case reported by Behrend,[2] this plan proved perfectly successful; combined, however, with the internal administration of calomel.

But when the tumor refills as fast as it is emptied by the trocar, some other method must be practised if the child's life is to be saved. The operations which have been used are (1) injection, (2) ligature, (3) excision. Issues and setons have also been employed, but not since the anatomy of the disease has been understood. Their use would now be quite unjustifiable.

1. Injection of the sac is by far the most promising method. Tincture or solution of iodine is the only fluid with which, as far as appears, the experiment has been made; and its success has been sufficient to make us hesitate before using any other agent. In fact, it is difficult to conceive of any other which would unite in so great a degree efficacy with harmlessness. There are two principal methods of using iodine injections in this disease. By the first, which we may call the

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[1] See a case by M. Viard, Bull. de la Soc. de Chir., 1860, 2me sér. tom. i., p. 616.

[1] Med. Chir. Trans., vol. ii., p. 324.

[2] Journ. f. Kinderkrankheiten, vol. xxx.

American method, the sac is not emptied, but a certain amount of the fluid is drawn out of it, and its place supplied by the iodine solution. Even this mixture is sometimes withdrawn from the sac, after having been left to act upon its lining-membrane for a few minutes. This was the method adopted by Brainard, of Chicago.[1] In the other, or the French method, introduced by Velpeau, all the fluid is withdrawn from the sac, which is then injected with tincture of iodine and water, like a common hydrocele. Numerous successes are claimed for both methods. Dr. Caradec, of Brest, operated on three cases by iodine injection; two were cured, and in the third case success appeared probable, when some imprudence, on the part of the child's mother, led to a fatal issue.[2] In a report on this subject, published by M. Debout in the Bulletin de la Société de Chirurgie de Paris, 1863, p. 612, the reporter states that Brainard had operated in 6 cases, 5 of which had been successful; and that Velpeau's method had been adopted in 10 cases, of which 5 were cured, 4 died, and 1 failed. I must confess that I look on these figures with some slight suspicion. Brainard himself, in reporting a seventh case, gives what seems quite a different version of his success. He says,[3] that he has treated 7 cases of spina bifida with iodine injections; that 3 out of those cases were uncomplicated with hydrocephalus, and that all these 3 were "perfectly and permanently cured." There is, however, I think, no doubt that injection has proved far more successful than either of the other two plans, and should always be used, when not plainly contra-indicated, in any tumor in which active treatment is considered necessary. It is highly desirable, if possible, to stop the communication with the spinal canal, in order that the injection may not excite inflammation in the cavity of the membranes. Therefore, those tumors which are pedunculated, or have a very small orifice, are best suited for this treatment. Superficial tumors are also more likely to be successfully treated than those which are covered with a mass of soft parts, on account of the impossibility of commanding the orifices in the latter.

2. The ligature of the pedicle of the tumor, by instant strangulation, has been practised frequently; but, I believe, always with fatal effect. The gradual compression of the pedicle by means of quills laid on either side, and brought gradually towards each other, was devised by Benard;[1] and Dubois effected the same purpose by means of a clamp placed on the neck of the tumor.[2] It does not seem essential to the success of this operation that the tumor should be removed; but when the neck has been divided, it may be as well to do so. This plan would be only applicable to the same kind of tumor as the iodine injection, and it appears far more dangerous.

3. There remains the operation of excising the sac. As several cases of successful excision are on record, it would, I think, be rash to proscribe the operation in a disease so fatal in itself as spina bifida. The tumor, if covered with healthy skin and fat, may be laid bare, and the cyst opened by an incision on one side of the middle line, cautiously enlarged to the extent necessary to see into its interior. If the cord or large nerves are seen, the operation must be given up. Otherwise the sac is to be removed, a portion being retained large enough to cover the orifice in the canal completely. This portion is to be implanted into the tissues around the orifice by points of silver suture, and the integument united over it. The only prospect of success for this operation is the faint chance that the parts may heal over the orifice of the sac, without such an amount of inflammation as would spread to the general cavity of the membranes. I have operated once in this manner; but the result was fatal. In a successful case in France,[3] the écraseur was used to divide the neck of the sac ("*je ne sais trop pourquoi*," says the reporter of the case naturally enough); and though a hole was left into the spinal canal larger than the end of the finger, the patient (fourteen years of age) recovered without a bad symptom. The following note appears on p. 111 of the French translation of my work on the Surgical Diseases of Children:—"Excision followed by suture, as recommended by Brunner, has been practised

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[1] Brainard's method of operating is thus described by himself. Six ounces of fluid were drawn off; half an ounce of a solution of 5 grs. of iodine and 15 of iodide of potassium to the ounce of water was injected, then, after a few seconds, allowed to flow out; next the sac was washed out with water; and finally 2 oz. of the original cerebro-spinal fluid (kept for the purpose at the temperature of the body) was reinjected. All this was done under chloroform, and pressure was afterwards applied. Brainard, op. infr. cit. (Note [3].)

[2] Union Médicale, 1867, pp. 402, 467.

[3] Am. Journ. Med. Sc., July, 1861, p. 65.

[1] Gaz. méd. de Paris, tom. ix., p. 573. A successful operation on this plan by M. Latil is quoted by M. Larcher on p. 109 of his translation of my work on the Surgical Treatment of Children's Diseases, from the Bulletin de Thérapeutique, tom. i.

[2] Laborie, op. cit.

[3] Bull. de la Soc. de Chir., 1860, p. 664.

by Trowbridge, and afterwards by Dubourg, in three cases, and twice with success. The sac being opened, the opening into the spinal canal was closed by the finger and the superfluous part of the sac removed, so that what remained could be brought down and united accurately at the situation of the opening, by means of the twisted suture. This description is taken from a work of Bouchut. M. Royer and M. Nott have also employed this method, more or less modified, and both unsuccessfully. (Royer, Bull. de l'Acad. de Méd., vol. xxxi., p. 33; Nott, Gaz. méd., 1856, p. 102.)"

Dr. Wilson, of Claycross, has removed a spina bifida twice with success. In the first operation,[1] he previously compressed the pedicle of the tumor (which was in the dorsal region) with a clamp; the object being to induce a new action in the pedicle and the secreting sac, to isolate the latter partially, and to ascertain the constitutional effects of interference with the neck of the tumor. This being well borne, the tumor was removed, the edge of the membranes touched with a red-hot knitting-needle, and the skin united with wire sutures. The child recovered perfectly. In the second case, the tumor was over the last lumbar vertebra; the child, two years old, was in a state of great exhaustion, and there was constant discharge from the wall of the sac, which was thin and membranous. The tumor was removed as in previous cases, but without any previous use of the clamp, and the child recovered perfectly.

Signor Rizzoli, of Bologna,[2] removed a cervical spina bifida, by means of the clamp, or entérotome, applied to the neck of the tumor, so as to bring its parietes into accurate apposition. The sac sloughed, and was removed on the fourth day, and the clamp was taken off on the following day. The child recovered completely, and the hole (which was in the fourth vertebra) rapidly cicatrized.

The same surgeon relates a most interesting case under the care of Signor Berardi, of a large and long spina bifida in the coccygeal region, and much resembling a tail, which hung down to the middle of the leg. This was cured by repeated evacuations of its fluid contents, and the obliteration of its pedicle by pressure with pieces of wax bougie, followed by the amputation of the appendage.

Another method of operating with the knife, though it can hardly be called excision, has been practised by Mr. Borlase Childs.[1] It consists in opening the tumor, pushing its collapsed parietes back into the canal, and uniting the soft parts over all, tightly enough to prevent the re-protrusion of the sac. The only attempt yet made in this way was fatal; and I confess that it seems to me even more dangerous than excision.

I do not think we are in a condition to point out in what cases each of these methods of operating is indicated; but as far as the limited experience, above referred to, would justify a conclusion, it would seem that the total excision of the tumor does not involve more risk than the method of ligature. Dr. Wilson, whose practical experience in this matter entitles his opinion to respect, urges the applicability of the method to cases of pedunculated tumors, in which symptoms, persisting in spite of milder treatment, seem to justify operative measures. And no doubt, there is much less risk in operating on a tumor which, being pedunculated, is less likely to contain the spinal cord or larger nerves, and whose channel of communication can be commanded while the sac is being removed. But then there is less likelihood of need for operation in such cases, since they are just those which are most amenable to pressure or injection. In cases where the tumor is sessile, and where the symptoms call for operation, excision is the only available resource; but it is far less likely to succeed. Thus it was in my case, referred to above, and which proved rapidly fatal from diffuse meningitis.

In some works[2] will be found a tabular statement of the supposed indications and counter-indications to operative measures in these cases; but such elaborate statements, while far from being beyond criticism, do not appear to be of much practical utility. No case of spina bifida ought ever to be subjected to any active operative interference, except in the most urgent circumstances; and in every case the mildest measure which holds out any rational prospect of cure should be the one selected.

False spina bifida.—This term includes several perfectly different forms of superficial tumor, all of which agree in this leading feature, that they communicate with the cavity of the spinal canal, but not with that of the membranes. They are, 1. The sacs of true spina bifida, the necks of which have become obliterated, and which have thus become detached from the membranes. 2. Congenital tumors. 3. Included fœtal remains. Like the true spina bifida, these are more common in the lower part of the column.

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[1] Path. Soc. Trans., vol. xiv., p. 214.

[2] Memorie chir. ed ostetriche, vol. ii., p. 565.

[1] Behrend, op. cit., case 19.

[2] E. g. Behrend, op. cit., adopted from Laborie.

1. Pedunculated sacs, which communicate with the spinal theca by a narrow channel, may have that channel closed, either by inflammation occasioned by the dragging of the tumor and the pressure of the parts around, or by the growth of the bones encroaching on the membranous tube. Such is believed to have been the history of a remarkable case, which Mr. Solly has recorded in vol. xl. of the Medico-Chirurgical Transactions. It must be allowed that the precise nature of the tumor in this case is doubtful; but other instances (although very few) of this kind of spontaneous cure are recorded.[1] Its occurrence will be known by the obliteration of the tube of communication between the sac and the laminæ, and the feeling of those bones ossified beneath the tumor. Under these circumstances, an operation for the removal of the tumor is justifiable, though it can hardly be considered necessary.

2. Congenital tumors inside the spinal canal are of very various kinds. The most important are found in the sacral region, and these have been discussed in a preceding page (835).

3. The question of included parasites has also been discussed above.

In considering the question of removing a false spina bifida, its connection with the spinal canal, and with the great cavities of the body (as the pelvis), must be carefully investigated: and in the pelvic region a thorough examination of the rectum and genital organs must be made. If the tumor is free from both these sources of danger, it may be operated on without scruple. If it be in such close connection with the canal as to lead to the inference that it springs from its interior, but still, from its unvarying size under pressure and from other circumstances, a hope is entertained that it may have no communication with the membranes, it may be made the subject of treatment, should the symptoms justify interference. In that case, if the tumor be purely cystic, iodine injection is no doubt the proper measure; but in mixed cystic tumors this will probably fail. It may be tried, however, if the cyst bears a large relation to the bulk of the whole tumor; and it is not till after its failure that it would be advisable to debate the very difficult and doubtful question of excision.

Imperforate rectum is a deformity which, though sufficiently rare to prevent most practitioners from having much individual experience of it, is yet common enough to cost the lives of many children every year. Now most of those who have seen much of children's diseases will agree that the lives of the majority of these patients might have been saved, and the patients restored to perfect health, by very simple means, had the medical attendant been more familiar with the nature and treatment of the deformity. In some cases, it is true, life can hardly be preserved; in some it can be preserved only at the cost of the infirmity of an artificial anus; but these are the minority; in the greater number, if a very simple operation be performed promptly, no traces of deformity will remain in after life. It is very important, therefore, to be familiar with the several kinds of this malformation and with the treatment which each of them requires.

Cases are sometimes met with in which the anus is only partially obstructed. Of this rare form of malformation the following instance occurred to me. A female infant a few days old was sent to the Hospital for Sick Children, who had a fecal fistula in the back part of the vagina, but was said to pass feces also naturally by the anus. Believing, however, that such a fistula could only be accounted for by a congenital defect, I examined the anus, and found it would hardly admit a common probe. The rest of the aperture was blocked up by a membrane of no great thickness. The fistula which communicated with the vagina was much larger than the orifice of the anus; so that hardly any feces passed by the latter. I enlarged the anus to the proper extent by freely incising the membrane, and keeping the part dilated with a good-sized bougie. By the time the anus would easily admit the little finger, the fistula seemed nearly closed, and little or no fecal matter passed. After this I lost sight of the patient.

Cases of imperforate rectum may be divided into two classes, viz., those in which no anus exists (imperforate *anus* properly so called), and those in which there is an anus leading into a cul-de-sac (imperforate *rectum* in the narrower sense of the term). The former class (imperforate anus) may be again subdivided into —1. membranous obstruction of the anus; 2. complete or partial absence of the rectum; 3. communication of the rectum with the vagina in the female; 4. communications with the urinary tract in the male; 5. external communication or fistula. The latter class (imperforate rectum) may be subdivided into—1. membranous obstruction; 2. deficiency of the upper portion of the rectum.

Imperforate anus is so far a less dangerous affection than imperforate rectum, that it attracts immediate notice. Either at the time of delivery, or very soon after, the medical attendant or the nurse observes that the natural opening is absent, or that there is an unnatural one. In cases of imperforate rectum, on the other hand, the malformation is overlooked, and the child's sufferings are at first attributed to every cause except the right one.

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[1] In a debate at the Soc. de Paris (Bulletin, 1860, p. 387), M. Debout is reported to have said that he knew of only five cases of spontaneous cure; three in the coccygeal region, and two in the lumbar.

A. *Imperforate Anus.* 1. *Membranous obstruction.*—When a child is born with imperforate anus and without fecal fistula, the first question is, whether it is not merely an example of the first of the five subdivisions above enumerated. These cases of membranous closure of the anus constitute, I believe, a great majority of the whole; and a simple incision obviates all danger to life. This simple variety is known by the bulging, at the situation of the anus, which is seen when the child cries; and also, if the membrane is thin, by the color of the meconium being seen more or less distinctly through it. But in order that either of these signs may be noticed, the gut must be distended with meconium, which is not always the case at the time of birth. However, if the gut be not full, the child will not suffer any inconvenience; so that in case of imperforate anus where no bulging can be seen, and no symptoms are present, it is right to wait for a certain time (varying with the progress of the case, a day may be taken as an average), in order to allow time for the descent of the meconium, before undertaking any treatment. When bulging is perceived, all that is necessary is to make an incision of sufficient size in the situation of the natural anus, and give exit to the contents of the gut. This being done, some of the tissue on either side of the incision may be cut away, in order that the opening may be less liable to close, and it must be maintained open by passing a small bougie, or the end of the finger, into it daily, or twice a day, for some weeks. Whether the incision is to be a simple one in the middle line, or a crucial one, appears to be a matter of indifference; but the former is quite sufficient, and the latter is open to the theoretical objection that the fibres of the external sphincter, which is present in these cases,[1] may be injured. After this operation, if indeed a proceeding so simple deserves the name of an operation, the infant is usually restored immediately to perfect health, and the parts in after life have all the natural appearance and functions. But if no treatment be undertaken (which is unfortunately too common, in consequence of a kind of general impression of the necessary fatality of the malformation), the abdomen becomes tumid and hard, the infant refuses the breast, vomiting comes on, which soon becomes stercoraceous, and the patient dies in a few days from exhaustion, or more rapidly from bursting of the intestine.[1] If the symptoms have come on before the child is seen, the aspect of the case is less promising; but the same course should be pursued. In a case under my care, in which the child was in a state of great distress from distension and fecal vomiting, rapid recovery ensued on the restoration of the natural passage.

2. *Complete or partial absence of the rectum.*—When no bulging is perceived, after waiting for a reasonable time, it is probable that the lower end of the rectum is deficient. In such a case, if the external parts exhibit no obvious malformation, an exploratory operation should be performed, the object of which is to discover the end of the rectum, and if possible to draw it down, and attach it to the skin in the situation of the anus. For this purpose a free incision should be made from a short distance behind the scrotum, or vulva, in the middle line, to the point of the coccyx; the parts should be carefully dissected, the dissection being conducted along the front of the coccyx and sacrum; and if a bulging tumor can be felt, it should be gently drawn downward by means of hooked forceps and brought down, if possible, to the skin, attached there by sutures on either side, and opened; but if this is not possible, it should be opened *in situ*, and after the evacuation of the meconium, gentle traction by forceps should be used to draw it down as far as possible. If the gut can be attached on either side to the skin, the risk of subsequent contraction of the orifice is much diminished, and the danger of extravasation of feces into the cavity of the pelvis avoided. If this cannot be done, the opening must be maintained by the daily passage of a bougie, or other dilating instrument. I have found a pair of dressing forceps a convenient instrument for gently dilating the opening. If the opening can be kept to a proper size, even when the gut has not been drawn down, the power of controlling the feces may be hoped for. A sphincter muscle has been proved by dissection to exist in a case of this kind of malformation; but if the gut have been attached to the skin, its circular fibres will assume the office of a sphincter, even when no external sphincter exists.

When the rectum is entirely absent, the

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[1] See Path. Soc. Trans., vol. v., p. 176.

[1] The intestine has given way as early as the fourth day. Path. Soc. Trans., vol. ii., p. 226. Curling, Med.-Chir. Trans., vol. xliii., p. 305.

above proceeding will fail. The dissection will disclose no bulging tumor; and then the surgeon will be justified in proposing to open a higher part of the large intestine, and form an artificial anus, in order to save the child's life. The questions connected with this operation will be considered presently.

In cases of imperforate anus where malformation is obvious externally, the parts of generation being very far back, the tuberosities of the ischia very near together, and perhaps the skin in the situation of the anus much depressed, there is more reason to fear that the rectum is altogether wanting, and more danger of wounding the male bladder, or the female uterus and vagina, and the peritoneal pouches, in the dissection, than where the parts are more naturally formed. In such cases, the exploratory operation must be conducted with great caution; and if the above characters are very marked, it will become a serious question whether it would not be justifiable to resort to colotomy at once. It will, however, in most (if not in all) cases be possible, and be the more prudent course, to make an opening between the coccyx and the parts of generation sufficiently large to introduce the finger and feel for the rectum; but in these cases great care must be taken not to injure the parts in front.

3. *The rectum communicating with the vagina.*—The third variety of imperforate anus is that in which the rectum ends either by a small sinus, or by a continuation of its entire tube, in the posterior commissure of the vagina. This is a far less serious defect primarily than the former, since the feces pass in sufficient quantity to avoid any serious symptoms, and an infant does not suffer any material inconvenience from the flow of feces through the vagina. Hence the parents often do not present the child for treatment till it is several weeks or months old. But the secondary consequences of the deformity are usually very serious. The sinus is often not large enough to permit of a sufficient evacuation of the gut, when, with advancing life, the feces become more solid. This gives rise to increasing distension of the colon, which has sometimes proceeded to a frightful extent, and proved the direct cause of death.[1] Besides, the disgusting nature of the infirmity calls for prompt treatment before the child is old enough to be sensible of its inconveniences.

The inconvenience caused by a communication between the rectum and vagina varies very considerably. Thus a case has been recorded by M. Le Fort,[1] in which a married woman was discovered on rectal examination to have imperforate anus, the rectum opening obliquely into the back of the vagina. In this case the command over the feces was so perfect that no inconvenience resulted; and neither she, nor her husband, nor the accoucheur who had delivered her three times, were aware that there was any peculiarity about the sexual organs. Such cases as these should not be interfered with. On the other hand, when the communication is either so small as to oppose an obstacle to defecation, or so large and destitute of sphincter-power as to entail disgusting consequences of recto-vaginal fistula in after life, no time should be lost in commencing the operative treatment. The latter is often very difficult and complicated. I have now under treatment a girl about seven years of age, whom I saw in early infancy, and on whom I have performed numerous plastic operations, at intervals, during the whole of that time. The cure is now almost complete.

Signor Rizzoli[2] has given an interesting account of four cases of this malformation, in all of which he succeeded in restoring the parts completely to their natural relations and appearance by dissecting away the end of the rectum from the back of the vagina, through a free incision in the median line, and then bringing down and fixing the end of the gut in the natural position of the anus, after which the parts between the anus and vulva were united by sutures so as to form the new perineum. In some of the cases the lower portion of the rectum was so contracted that it was necessary to open it freely in order to obtain a sufficient anal orifice; and in some cases the difference in length between the anterior and posterior walls of the gut, due to its curved direction, caused some difficulty in drawing it down to the proper position. This difficulty however was overcome by careful dissection. The accompanying figures from Sig. Rizzoli's work will illustrate this method of operation [p. 847].

There is usually no difficulty in finding the end of the rectum, by passing a director down the unnatural opening. The perineum should then be freely divided from a short distance behind the posterior commissure of the labia nearly up to the coccyx; and after having, if necessary, opened the rectum by cutting on the director, the operator should endeavor to draw down its walls, separating the front wall from the vagina, and attach them to the skin. If this cannot be done, at any rate a free opening must be maintained in the situation of the natural anus, in the hope that the recto-vaginal fistula may close, which, if it be small, appears to be the case tolerably often. If it does not close, some plastic proceeding analogous to that which is used for rupture of the perineum in the adult will probably be necessary. But for the success of such operations the bowels must be more under control than can be the case in early infancy; so that it is advisable to delay the operation, and to ascertain, by experiment, before performing it, that the

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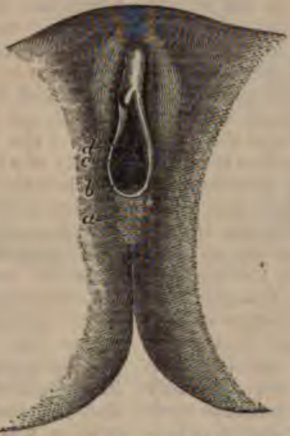
[1] Brit. Med. Journ., 1858, p. 845.

[1] Le Fort, Des Vices de Conformation de l'Utérus et du Vagin. Paris, 1863, p. 120. M. Ricord also has put on record a case in which a woman was in the constant habit of sexual intercourse, and had lived with one man for three years, without his suspecting any malformation. Gaz. des Hôp., 1833, p. 412.

[2] Memorie chirurgiche ed ostetriche, vol. ii., p. 321. Bologna, 1869.

Fig. 948.



The parts before operation. *a*, the perineum, extending to the coccyx. *b*, the opening of the rectum into the vulva. *c*, a fibrous membrane continuous with the hymen (*d*), and uniting the labia majora to each other and the rectum.

Fig. 949.

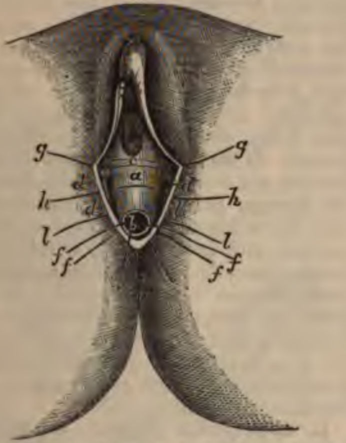
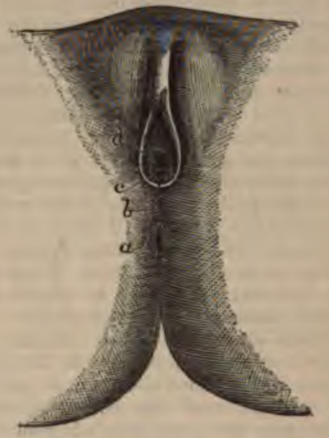


Diagram of the operation. *a*, the lower part of the rectum, which has been exposed by a free incision in the median line, extending through the tissue marked (*c*) in the last figure, and drawn down towards the coccyx (*e*). *b*, anal opening of the rectum. *c*, remains of the membrane continuous with the hymen. *d d d d*, the divided muscles and other tissues of the perineum. *f f f f*, two sutures passed through the lower end of the rectum, securing it in its new position. *g g*, *h h*, sutures, reuniting the divided perineal tissues. *l l*, a suture uniting the perineal tissues to the anterior edge of the rectum.

Fig. 950.



The parts after operation. *a*, the anal orifice of the rectum in its normal position. *b*, the median incision united and forming the raphé of the new perineum. *c*, remains of the tissue marked with the same letter in the previous figures. *d*, the hymen, somewhat displaced backwards by the tense membrane *c*. This was the only abnormal appearance which the parts presented after the operation.

child's bowels can be kept constipated for several days without danger. Dr. Rhea Barton succeeded in effecting a cure by the simpler method of laying all the parts open from the vaginal fistula down to the natural situation of the anus, and then encouraging the front part of the wound to close, while the back part was kept open. Another American surgeon successfully repeated the same operation.[1]

4. *The rectum communicating with the urinary tract.*—Communications between the lower end of the bowel and the male urinary organs with imperforate anus constitute perhaps the most troublesome variety of this affection. It is true that the malformation does not prove immediately fatal, since the feces are at first sufficiently liquid to pass by the urethra without much residuum. But as they become more solid, a residuum is left, which, being impacted in the urethra or bladder, according to the level of the communication, produces the ordinary symptoms of calculus, with perhaps even more than the ordinary amount of retention of urine. It is important, therefore, to operate before this has taken place. The communication may be either with the urethra or the bladder. In the former case, it may in some instances possibly be discovered by the sound; but usually the seat of the communication remains uncertain. Should the gut terminate in the urethra, the rectum will only be deficient in its lowest part, and its termination will be accessible from the perineum. Therefore, the proper course is to begin by performing the usual exploratory operation in the perineum; and if the rectum be met with, to separate it from its connections, if possible, and draw it down to the skin, as in the last case. I am not aware, however, of a case in which this has been successfully accomplished. If the rectum be not found, the inference is that the communication is with the bladder; and in that case the rectum may be totally absent, and the communicating intestine may be some much higher part of the alimentary tube. In such a case, I think that colotomy should be recommended; but it is a very doubtful question, the decision of which may reasonably be left to the parents, if they are persons of sufficient intelligence. Some further remarks on colotomy in these cases will be found in a future paragraph.

If the child is not seen until a later period, when the symptoms of fecal accumulation in the urinary tract call for some relief, attention must first be directed to this accumulation. The mass must be broken down with the catheter, and removed by the free injection of warm water; or if it be very solid, it may even be advisable to use the lithotrite. Then the case must be treated according to the rules above laid down. The proposal, which has been sanctioned by some surgeons, of cutting down in the middle line into the urethra and neck of the bladder, and thus laying the whole tract for the urine and feces into one, appears unadvisable, as it would very likely end in leaving the patient with the horrible infirmity of a large cloacal aperture, through which both the urine and feces would pass without control.

5. *Imperforate anus with fecal fistula.*—The cases of imperforate anus in which a fistula exists opening externally are not immediately threatening to life; and if the external opening be in a situation where the discharge of the feces will not be dangerous or very inconvenient (*e. g.*, behind the natural position of the anus), it may be a question whether they require any treatment beyond such dilatation as may be necessary for the perfectly free discharge of the feces. Such openings have been known ultimately to acquire sphincter power. But when the opening lies in front of the natural position (in the scrotum [fig. 951], or close to the vulva, according to the sex), it is advisable to cut down in the proper place, and attach the gut to the skin. The operator may be sure of finding the rectum lying close to the skin of the perineum. If the abnormal anus be in some remote place (as in the hypogastrium, on the dorsum penis, in the groin), the case assumes a much graver aspect, since the rectum, and perhaps the whole large intestine, may be absent or impervious. In most of such cases it will, in all probability, be judged better to dilate the abnormal anus, if necessary, and abandon the case to nature. In very few instances would it be justifiable to attempt to restore the natural opening.

B. *Imperforate rectum.*—We have now to consider the cases of imperforate rectum in the narrower sense of the term, *i. e.*, cases in which the external parts are normal, but the anus leads into a small cul-de-sac, the rectum being totally obstructed above. [Fig. 952]. Such cases (as has been before pointed out) usually require immediate treatment; the deformity having been at first overlooked. The obstruction of the rectum may be due to a simple membrane stretched across the tube of the intestine, which in other respects is natural; or the upper tube (the rectal cul-de-sac, as it is called) may lie by the side of the lower (the anal cul-de-sac), or behind it; or the rectum may be impervious for a greater or less

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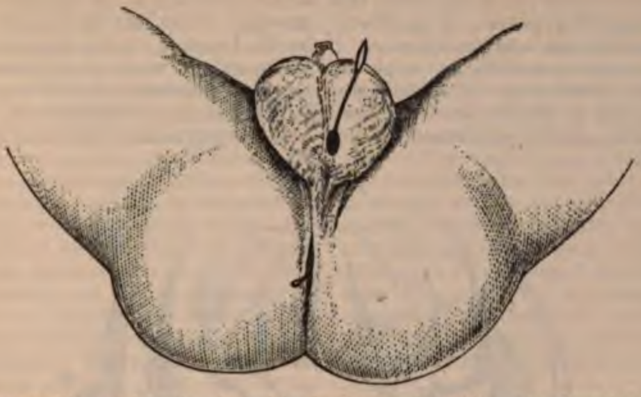
[1] Bodenhamer, Congenital Malformations of the Rectum and Anus. Cases xcvii., xcviii.

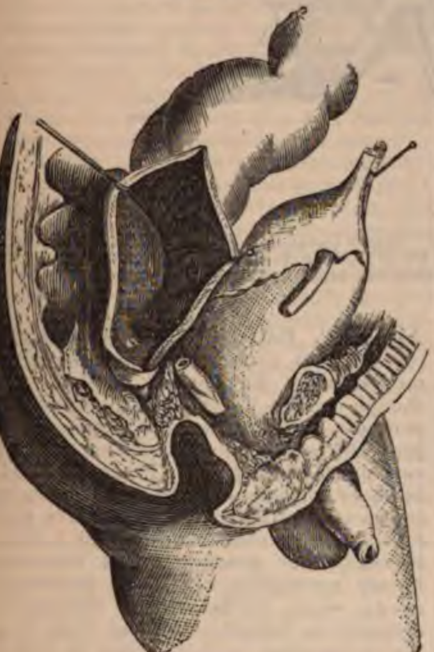
[Fig. 951.



Imperforate rectum with scrotal fistula. An incision has been made into the rectum from the natural situation of the anus, and a probe passed through this incision from the scrotal fistula. (From Holmes's Surgery.)]

distance, so that the colon may terminate by a dilated extremity above the pelvis. In rare cases, the sigmoid flexure itself, and more or less of the rest of the large intestine, may be absent; but as such infants are usually not viable, the cases present little practical interest. Practically, cases of imperforate rectum may be divided, as above, into two classes, *i. e.*, 1. where the upper cul-de-sac is accessible from the lower; and 2. where it is not.

[Fig. 952.



Imperforate rectum. The bowel terminates at the middle of the sacrum. There is an anal cul-de-sac, separated by a small cellulo-fibrous interspace from the bowel. (From Holmes's Surgery, after Giraldès)].

The chief means of distinguishing one variety from the other is the sensation of bulging communicated to the finger passed into the anal cul-de-sac. The presence of this symptom may be taken as indicating that the two cul-de-sacs lie close together. As a matter of prognosis, it ought to be borne in mind that this bulging has been felt in a case where it proved to be due not to the impulse of feces in the rectum, but to that of fluid in the recto-uterine pouch of the peritoneum;[1] but as an indication of practice it may always be held to justify the surgeon in exploring the bulging tumor. This may be done either by incision or with a grooved-needle. If a puncture is made and meconium escapes, the puncture ought to be dilated with a pair of dressing forceps passed through it, until the meconium has been freely discharged, when a large catheter or tube should be fixed in the gut. If the surgeon prefers to use a grooved needle, and meconium is detected, the grooved needle may be used as a director, and a small knife passed along it. M. Guersant has recommended the use of a trocar and canula made in a peculiar form, so that the canula is grooved; but as a grooved needle answers every purpose, I should not be disposed to use a larger instrument. The practice usually pursued, of thrusting about trocars of considerable size in the tissues of the pelvis, is very dangerous; and if the gut is found, the opening made by such an instrument is always insufficient; so that the trocar ought to be discarded in these exploratory operations.

Numerous instances are on record in

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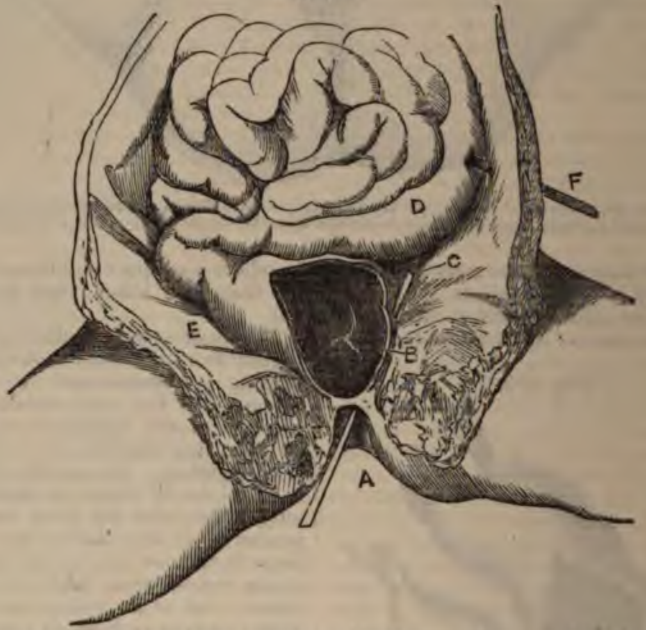
[1] Path. Soc. Trans., vol. xi., p. 99.

which the surgeon has failed to detect the presence of the rectal cul-de-sac with the trocar, although that portion of the bowel has lain close to the anal cul-de-sac. I have figured such a case in my work on the Surgical Treatment of Children's Diseases, p. 172, in which Littré's operation was subsequently performed, under the impression that the lower bowel was totally deficient. A similar case, under the care of the late M. Robert, is figured by M. Larcher in his translation of the above-named work, and I produce it here, since it illustrates another point which will be referred to further on.

Fig. 953.



Imperforate rectum. Failure of exploratory puncture. Littré's operation. A, anal cul-de-sac. B, rectal cul-de-sac. C, probe passed in the course of the trocar, which had been thrust behind and to the left of the bowel. D, descending colon. E, the sigmoid flexure passing over into the right groin. F, the colon opened by Littré's operation in the left groin.

If the gut cannot be found in this way (*i. e.*, there is no bulging tumor, or if the sensation prove deceptive), an operation similar to that for imperforate anus should be first performed. The anal cul-de-sac should be freely laid open towards the coccyx, and the parts in the pelvis dissected to as great a depth as may be thought prudent. On the failure of this operation, the question of colotomy will arise.

Colotomy in congenital obstructions of the lower bowel. — When the rectum is entirely deficient, the only means of preserving life is to open some higher part of the bowel; and when the gut opens into the bladder, and is inaccessible from the perineum, the same operation may be performed, although not immediately necessary for the preservation of life, as a means of avoiding the grave inconveniences and dangers which that malformation entails. The operation may be performed either according to Littré's method, or that which goes by the name of Amussat.[1] But the former is generally preferred in these cases of congenital malformation for several reasons, although it must be allowed that our experience of either is not sufficient at present to serve as a foundation for any very exact comparison. It may be said, however, that the only difference between the two operations is that Littré's is performed a little lower down and farther forward than Amussat's, and that the former necessarily opens the peritoneal cavity, while the latter may succeed in opening the intestine without wounding the peritoneum, in those cases in which the descending colon is not attached by a mesentery. But the latter advantage cannot be always attained, since the presence of a mesentery is not uncommon; and if there be a very long mesentery, it may be altogether impossible to find the large intestine.[1] Nor does it appear at all certain that the fatality of colotomy in these cases is due in any great measure to wound of the peritoneum. The tender age of the child; the weakness induced by distension, vomiting, and want of nourishment; and the tendency to peritonitis (in some cases its actual existence), from the congestion and straining motions of the intestines, sufficiently account for the fatal result which usually follows.[2]

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[1] These operations are described in Vol. II., p. 620 et seq. [See also the essay on OPERATIVE SURGERY, p. 616.]

M. Guersant opened the colon eleven times in the groin, and once in the loin, without saving one of his patients.[3] I have only been able to find a single successful case recorded since the publication of M. Rochard's paper,[4] although that publication must have given rise to the performance of many similar operations. In that case,[5] which occurred under the care of Dr. Pooley, in the State of New York, the operation was performed on an otherwise healthy male child in whom there was an imperfect rectum and a communication with the bladder. The report was published six months after the operation, the child being in perfect health. The feces passed about twice a day from the artificial opening, and the fecal discharge from the bladder appeared to have quite ceased. M. Giraldès, however, had a case of colotomy for imperforate anus in which the child lived two and one-half months, and died from another cause.[6]

In the rare cases where colotomy has been successful, some have lived through the ordinary term of human life, and have been able to perform without serious inconvenience the duties of laborious occupations, and the functions of wives and mothers.[7] These cases justify the performance of the operation, with the consent of the patient's friends, although it must be admitted that little success can be anticipated.

When the operation has been performed on account of a communication with the bladder, an additional annoyance is experienced in the fact that some feces may still pass beyond the artificial anus and reproduce the symptoms of vesical irritation. The surgeon must either deal with the symptoms as they arise, by breaking down the masses in the bladder from time to time, or he may make trial of a plug inserted into the lower opening, or he may even feel justified in attempting to cure the latter by a plastic operation. Space will not permit of a discussion of this rare complication; an interesting example of which is, however, recorded by Mr. Curling.[1]

A curious discussion has been originated by M. Huguier,[2] viz., whether, in performing Littré's operation in cases of imperforate anus, it would not be better to operate in the right groin instead of the left. He has noticed that in many cases of total absence of the rectum, the oblique bend in the colon, of which I have just spoken, brings it to terminate in the right groin. Hence he recommends to make the incision on this side instead of on the left. But all the successful cases which have been put on record have been operated on in the left groin; while no operation, so far as I know, has yet been practised on Huguier's suggestion, except one, which is related by Mr. Bryant in his work on Surgical Diseases of Childhood, p. 40. In this case, after failing to reach the bowel by an exploratory operation in the perineum, Mr. Bryant cut down on the right side by "a vertical incision, at a distance of one inch from the anterior superior spinous process, towards the umbilicus," and at once found a portion of large intestine, which was proved, after the death of the patient, to be the descending colon. This case, then, shows that M. Huguier's suggestion is so far practicable, that in some, at any rate, of these cases of malformation it is possible to reach the descending colon on the right side of the belly. The same fact is shown by a case which I have related in my work on Children's Diseases, p. 166; and by a case recorded by Mr. Ashton in the Path. Soc. Trans., vol. vi., p. 200, and many others. But this by no means settles the question. Allowing that in some cases the sigmoid flexure of the colon may be reached from the right side, two questions present themselves: 1. In these very cases could not the large intestine have been opened also from the left groin?

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[1] Mr. Curling practised both operations on the bodies of 20 infants who had attained the full period. Colotomy in the left groin was easy in 18 cases; in the other 2 the bowel curved over to the right side, so that to open it the incision must have been in the right groin. Colotomy in the left loin was easy in 8 of these subjects; difficult in 6; and impossible, without wounding the peritoneum, in the other 6. Curling, Diseases of the Rectum, 3d ed., pp. 222, 223.

[2] On the question of wounds of the peritoneum in operations, see the essay on INJURIES OF THE ABDOMEN, Vol. I., p. 909.

[3] Debout, in Bull. de Thér., tom. xlix., p. 116.

[4] Rochard, Bulletin de l'Acad. imp. de Méd., an 1859.

[5] Ann. Journ. of Obstetrics, May 1, 1870.

[6] Nouveau Dictionnaire de Méd. et de Chir. prat., tom. ii., p. 633.

[7] Curling, op. cit., p. 229. Rochard, op. cit.

[1] Op. cit., p. 226.

[2] Bulletin de l'Acad. imp. de Méd., tom. xxiv., 1858–9, pp. 435, 445.

2. If not, is the proportion of such cases sufficient to justify the proceeding? With respect to the first question, I cannot find any precise details on which to found an answer. Mr. Bryant does not describe the relations of the colon in his case in terms sufficiently precise to show that he had given particular attention to this point. In M. Robert's case, figured on page 850, it is plain that the colon could have been found with equal ease in either groin. In Mr. Ashton's case in the Path. Soc. Trans., vol. vi., he says, that "the ascending and transverse portions of the colon were normal: this intestine then descended a short distance on the left side, and, recrossing the abdomen to the right side, terminated in a dilated pouch," etc. Here, then, if the operator had cut down on the left side, and had not found the large intestine, enlargement of the wound upwards (not necessarily to a very great extent, considering the size of the parts) would have brought the descending colon into reach. What M. Huguier says may be very true, that from the right groin some portion of the large intestine is sure to be reached; but it seems to me to be by no means a matter of indifference whether the part opened be the descending part of the colon or the cæcum; and unless it could be shown that the sigmoid flexure is always, or almost always, on the right side, I should be decidedly in favor of the operation on the left side. The reverse, however, is, I think, very clearly shown. Thus M. Giraldès says,[1] "Numerous anatomical investigations, together with the records of those of Curling and Arthur Bourcart, have shown me that in the great majority of cases in the fœtus and new-born child the sigmoid flexure is placed on the left, and not on the right. In 134 autopsies below the age of a fortnight, I found the sigmoid flexure on the left side in 114; in 50 cases of Littré's operation which I have collected, the operator always met with the sigmoid flexure on the left side; in 30 post-mortem examinations of infants operated on for imperforation, the intestine was always found on the left; in 100 examinations of new-born children, Curling found the sigmoid flexure on the left side 85 times, and Bourcart, who made prolonged researches in order to elucidate this question, found the sigmoid flexure in its normal position 117 times out of 150."

The incision in the right flank has indeed this recommendation, that should the large intestine be altogether absent, a lower part of the remaining intestinal tube will more probably be reached on the right side than on the left. Such a malformation, however, must be very rare; and the infant would, I should suppose, be hardly viable.[1]

On the whole it seems better to operate in the left groin. Whether after failing to find the sigmoid flexure in that part, it would be the better course to make an artificial anus in the small intestine, or to perform a second operation in the opposite groin, must be left to the discretion of the operator. Neither course would have much prospect of success; but if the infant were healthy and strong, the latter might be justifiable.

In the Bull. de l'Acad. de Méd., tom. xxiv., 1858–9, p. 434, Velpeau gives the following advice: He operated on an infant with imperforate anus. Not being able to find the rectum by operation in the perineum, he resorted to lumbar, and then to inguinal colotomy, but gives no particulars of the operations. On the death of the infant, the rectum was found complete, but empty, and deviated to the right. He therefore advises that, after having opened the gut in the loin or groin, a probe should be passed down to ascertain whether the lower part of the gut is not present, and whether it may not be possible to establish the natural anus.

Imperforation of the small intestine.—Two cases of congenital obstruction of the lower part of the small intestine have been communicated by M. Depaul to the Acad. imp. de Méd., in which the diagnosis was successfully established; the following being the symptoms principally relied on: There were the usual symptoms of obstruction—the abdomen was swollen, the anus and rectum were natural, clysters would pass, but soon returned without meconium;[2] a flexible tube could be introduced for a considerable distance, but brought away no feces; it rather seemed to cause vomiting, the vomit being mixed with lumps of meconium. In a case of this sort auscultation and percussion would yield indispensable data. Littré's operation, at the point indicated by the part at which the intestinal resonance seems to stop (especially if the fluid injected can be heard to stop near the same point), appears the appropriate treatment, though little hope can be entertained of good from anything.

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[1] Leçons cliniques, p. 121. M. Giraldès refers here to two cases in which, in performing Littré's operation, he came upon an undescended testicle.

[1] In one curious case, recorded in the Path. Soc. Trans., vol. xii., p. 87, there was a kind of transposition of the large intestine, the ilio-cæcal valve being in the left instead of the right iliac fossa, and the transverse arch of the colon passing from left to right, and terminating in a very large cul-de-sac in the right iliac region. There were also in that case other malformations, not, however, apparently inconsistent with life. An exploratary incision from the perineum having failed, nothing further was done. In this case, had the course which I should have been inclined to pursue been followed, the cæcum would probably have been opened; but this is, I should suppose, a unique case.

[2] I once saw a case of this kind in which the diagnosis was rendered erroneous by the fact that we could not pass any large quantity of injection. In fact, it returned almost

Malformations of the umbilicus.—Another affection, probably due to congenital malformation, is that warty or nipple-like tumor projecting from the umbilicus, which is tolerably often seen in children, and seems due to some morbid condition left by the separation of the umbilical cord. Mr. Athol Johnstone, to whom we appear to owe our first accurate description of the disease in the English language,[1] speaks of it as "a stout nipple-shaped papilla or tubercle, rising from the centre of the main umbilical depression;" and says that he has seen it attain the height and circumference of an inch. I have had several cases, but none of this size. Mr. Cooper Forster and Mr. Bryant also speak of this affection. In most cases the tumor is solid; in some a minute canal extends along it for a short (but only a short) distance. No water flows along this little canal, nor does the canal lead into the bladder. The treatment of these cases is exceedingly simple; a ligature tightly applied being all that is necessary.

Umbilical fistulæ.—There are other though less common cases in which the urachus remains open[2] and the urine is discharged from the navel; or in which there is a fecal fistula, congenital or acquired;[1] or in which there is a biliary fistula at the navel.[2] These cases must be distinguished from the foregoing trivial affection, as can readily be done by the character of the discharge.

The cure of such fistulæ should be attempted, but with caution. The actual or potential cautery applied to their edges can do no harm. It has, however, failed in all the cases that I am acquainted with, and then a plastic operation ought to be attempted. But I cannot encourage the reader to be very sanguine of success by this method either. In the two cases related by Mr. Cooper Forster such an operation was performed; but it does not appear to have succeeded in either. Mr. Bryant's case was not made the subject of any treatment. In mine the treatment by cautery failed, and I lost sight of the child before performing the plastic operation which I contemplated.

A very singular case, the result of malformation of the umbilicus, was sent to me a year or two ago by Dr. Harland Whiteman, of Putney.

The infant was a male prematurely born, and on its birth the funis was noticed to be bifurcated, and it appeared to Dr. Whiteman as though one bifurcation contained the arteries, and the other the vein. This bifurcation commenced about three inches from the umbilicus, and the part of the cord attached to the belly was marked by a rather thick gelatinous septum. The funis was tied and divided below the bifurcation. Nothing was noticed as being wrong for a fortnight. The nurse was observed to be unwilling to be seen when engaged in dressing the cord, but always replied that "all was going on right," until, at the age of about fourteen days, Dr. Whiteman was again summoned on account of a bad smell from the navel, and the nurse having reported that there was something wrong about it. On examination, it was seen that inflammation and ulceration extended to some distance around the umbilicus, and there was also sloughing still going on of the septum and of what remained of the right

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instantly. After death, however, the obstruction was found quite high in the small intestine. The fulness of the abdomen and the straining of the abdominal muscles were the only causes which I could conjecture for the obstacle to the passage of the injection.

[1] Lectures on the Surgery of Childhood, 1860, p. 44. The affection is said to have been first pointed out by Dugés, Dict. de Méd. en 15 tomes, t. xii., p. 159.

[2] In the Med.-Chir. Trans., vol. xxxiii., p. 293, there is a case reported by Mr. Paget, of Leicester, of patent urachus, in which the patient, a man æt. 40, labored under symptoms of stone. The unnatural opening was of large size, an inch in diameter; notwithstanding which he could retain about a pint of water, and only a little escaped in micturition. There was also hernia at the opening. The calculus had formed on a hair, which had probably slipped down accidentally from the pubes. It was extracted by passing the finger down the patent urachus. No operation was attempted on the patent urachus. See also Bryant, op. cit., p. 144.

[1] Cooper Forster, Surgical Diseases of Children, p. 107.

[2] I have seen no published case of this affection; but a boy, æt. 10, was under my care in the year 1862, on account of a discharge of pure bile from the umbilicus. This was said to have followed the removal of one of the warty tumors above described. The fluid responded to the usual tests for bile, and, as well as could be ascertained, was free from any fecal admixture. The sinus from which this fluid exuded was so minute that I could form no idea of its direction, but it seemed to extend a considerable distance.

bifurcation. This bifurcation contained no intestine. The sloughing portion was included in a ligature. The opposite bifurcation (on the infant's left) contained intestine; there was a deep sulcus or fissure at the bottom of it, close to the umbilicus, out of which an offensive fecal discharge continually exuded. Some feces, however, still passed by the anus; but this ceased as the gut protruded out of the navel, and its whole circumference gradually became ulcerated, so that the intestine was divided into two parts at the time that I saw the child. There was then a large coil of intestine hanging out of the belly, and partly everted, the feces exuding from its open mouth. Another smaller coil, which transmitted no feces, lay on its right side, separated from it by a slight depression or septum, apparently, as I thought, a part of the mesentery.

It appeared evident that there had been some defect in the closure of the umbilical aperture, probably dependent on the fissured condition of the cord, and that into one of these fissures a herniated portion of the gut had protruded. The ulceration of the intestine, and its ultimate division into two parts, were equally evidently the result of mechanical violence, which could not have been applied at the point where Dr. Whiteman tied the cord, even if it were possible (which, of course, it could not be) to overlook a protrusion of more than three inches of small intestine, or to tie it without producing any symptoms for several days. It appeared, therefore, more than probable—in fact, nearly certain—that the nurse, ignorant of Dr. Whiteman's reason for leaving so large a part of the cord, had at a later period applied another ligature close to the umbilicus, to hasten its separation, and had unwittingly injured the intestine, which by this time had protruded.

When I saw the infant, its death, if unrelieved, was certain, as the protrusion kept increasing. There was, indeed, nothing to oppose its increase when the child cried or coughed. I was unwilling to abandon it to death without treatment, and the only courses which seemed open were, to endeavor to press back the gut by pad and bandage, or by some plastic proceeding to endeavor to divert the feces from the surface of the body to the lower coil of the intestine. The former plan, I thought, must necessarily prove fatal, as pressure applied on an everted mucous surface constantly covered by feces must be ineffectual in repressing the gut, and at the same time productive of great irritation, and probably of sloughing. I determined, therefore, to attempt Dupuytren's method of treating artificial anus. The two adjacent portions of intestine were accordingly brought into apposition along their serous surface by means of the entérotome, and the blades of the latter instrument were gradually tightened upon them. This plan promised at first to be successful; the intestine was repressed into the belly by the instrument, and on the third day after its application, feces began to pass from the anus. The motions continued to pass entirely per anum for four days, by which time the entérotome was separated, when, unfortunately, in a fit of coughing, the gut reprotruded, the adhesions which had united its two coils having given way, and the protruding portion became larger than it was before the operation. I reapplied the instrument; but the child rapidly sank, and died in a day or two. On post-mortem examination, the bowels were found smeared with a thin layer of pus; no other noticeable morbid appearances were present. The two divided portions of the small intestine lay in close apposition. The preparation is in St. George's Hospital Museum, Ser. ix., No. 103*a*.

With this case may be compared one figured in Path. Soc. Trans., vol. vii., p. 216, in which a pendulous triangular pouch hung out of the umbilical aperture, lying above the cord, and having an umbilical hernia at its base. The pouch terminated in two horns, each of which was perforated by an opening; and from each of these openings meconium passed. Meconium also passed from the anus. The pouch is represented as having consisted of an inversion of the bowel, one horn of the pouch being the ileum, and the other the cæcum. But as the passage was uninterrupted to the anus, and as both horns, though quite unconnected with each other, transmitted the meconium, it seems evident that the pouch must have been more in the nature of a diverticulum than of a prolapsed and inverted bowel. If the small intestine had protruded from the belly through some sloughy aperture, and its coats had become everted, so that the mucous coat presented externally, and the tube was exposed and transmitted meconium, it is clear that all the contents of the intestine would pass that way, and none could come either by the anus or by any lower portion of the intestine, which might be similarly prolapsed.

Hermaphroditism.—Most of the malformations of the genito-urinary organs have been treated of in former pages of this work: the malformations of the male urethra, producing hypospadias and epispadias, at Vol. II., p. 783; those of the penis which accompany extroversion of the bladder, at p. 754 of the same Vol.; those of the vagina and uterus, at Vol. II., p. 985; and those of the testes, at Vol. II.,

p. 892 et seq. There remains, however, the question of doubtful sex from malformation of the external organs, which is often brought to the surgeon to decide, and, as it seems, is often decided wrongly. The male organs may simulate the female in this way: the corpus spongiosum and the corresponding portion of the urethra are absent; the penis is small and the prepuce imperfectly formed, resembling a large clitoris; the scrotum is split, leaving a gap which represents the vagina; its two halves form cutaneo-adipose folds, representing the labia majora, between which is the orifice of the short urethra; and the resemblance may be completed by the testes being retained in the abdomen. The female organs may simulate the male by a great enlargement of the clitoris, causing it to resemble the penis, the presence of the ovaries in the labia,[1] and a very small vaginal orifice like the opening in hypospadias. The majority of cases of spurious hermaphroditism in the female present, however, merely the enlarged condition of the clitoris, and may be recognized for females with tolerable ease, by passing a sound up the urethra into the bladder, and examining by the rectum. The presence of a uterus and vagina between the finger and the sound will then be evident. Even in the rare cases where the ovaries may have descended into the labia, on one or both sides, this method of examination may yet clear up the matter; and if the vaginal opening be large enough to admit the finger, no doubt need exist. The question is often more puzzling in cases which are probably males, with cleft scrotum, as is evidenced by the case quoted by Sir J. Simpson,[2] from Otto, where an individual had lived ten years as a wife with three different men, who was yet afterwards affirmed by the Royal Medical College of Silesia to be a male. At the Pathological Society a short time since, a specimen was exhibited which elicited opposite opinions from very good authorities. Nor is it impossible that true hermaphroditism may in some cases exist—that is to say, that some parts of the male and female organs may coexist; as in the case of the sheep, described by Mr. Savory in Med.-Chir. Trans., vol. xlii., where, along with testes and other male organs, there was found a very perfect uterus and vagina. Also in the Pathological Transactions, vol. xi., p. 158, is the account of the dissection of the generative organs from a person regarded (and apparently correctly) as a female, but where a body much resembling a prostate was found; the urethra had the long course of the male, and the vagina could hardly be demonstrated. Some other cases will be found recorded by Sir J. Simpson.[1] Leaving aside, however, a few rare cases in which some doubt may exist, the careful examination of the folds simulating labia may detect a testis and cord (or a cord with rudimentary testis) on one side or both; or the proximity of the urethra to the rectum, with the development of the perineum, may prove the sex to be male; or the direct continuity of the supposed vaginal canal with the bladder may show that it is really a male urethra. Occasionally it is said that extroversion of the male bladder has been mistaken for the vulva, or that an adhesion of the penis to the scrotum has caused a doubt of the sex of the child. Such conditions, however, can hardly deceive one who is prepared for their occurrence.

In the few cases where the above tests give only uncertain results, a doubt must be allowed to rest on the sex of the child, which perhaps will be cleared up by the development of the breasts and the propensities displayed at puberty, or which may remain until dissection clears up the difficulty. In all cases of true hermaphroditism the sex would be settled by the intrinsic organs (testes or ovaries) which are found on dissection. When doubt exists as to the sex of a child, it appears more prudent to bring it up as a male than to expose it to the disgusting and disappointing consequences of an attempted marriage.[2]

It is but rarely that operative interference is justifiable in cases of hermaphroditism, and the operation consists always, as far as I am aware, in an attempt to enlarge the vaginal opening, so as to permit of sexual intercourse. A case of the kind under M. Huguier's care, in which the proceeding appears to have been successful, is recorded by M. Léon le Fort.[3]

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[1] This is not so very uncommon. A case was laid before the Royal Medical and Chirurgical Society, where Sir W. Lawrence, operating for strangulated inguinal hernia in the female, found the ovary in the sac. Mr. Pott's case is also well known.

[2] Cycl. of Anat. and Phys., art. "Hermaphroditism," the standard reference on this subject.

[1] See also a case by Rokitansky. Centralblatt f. die med. Wissenschaften, Berlin. Quoted by Larcher, op. cit., p. 284.

[2] Mons. Ad. Richard asserted some time since that all hermaphrodites are really males, however much the genital organs may approach the female type. Union méd., tom. iii., p. 543, Paris, 1859.

[3] Vices de Conformation de l'Utérus et du Vagin, p. 203. See also Larcher's translation of my work on the Surgical Treatment

I am not aware that any plastic operation has hitherto been attempted on hermaphrodite males; nor is there either the same motive or the same prospect of success, for the organs are probably too imperfect to be capable either of penetration or emission.

Malformation of skin.—The congenital[1] vascular tumors, or nævi, have been noticed above, with respect to their surgical treatment (TUMORS, Vol. I., p. 271). But besides these tumors there are other malformations, which consist chiefly in mere discoloration, often accompanied by a development of hair. Of the more extensive discolorations (which are more common on the face than elsewhere), the common "port-wine stain" is the most familiar example; and of those attended with development of hair, the ordinary mole. But there are rarer deformities of each kind, or involving a mixture of both kinds. Mr. Athol Johnstone informed me that he was consulted on account of a fine healthy baby, with an irregular dark-brown (almost black) streak extending across the root of the nose and invading the inner extremities of the eyelids on each side. The skin was thickened, and irregularly wrinkled and slightly elevated, and its surface was covered with short dark hairs. In this case the extent of the disease forbade any endeavor to extirpate it, which, however, in such affections it is particularly desirable to do if possible, both as a matter of appearance and from the undoubted liability of moles to become the seat of epithelioma. In the case of extensive maculæ no treatment seems to have any effect. In those less extensive, the skin may be destroyed by some powerful caustic, and thus the less disagreeable deformity of a white scar substituted for the stain. It might be possible perhaps to tattoo some of those maculæ with some substance which should produce a white color, and the suggestion has, I believe, been made, but I am not aware that it has been followed. The plan could hardly, I should think, be practically useful, except in maculæ sufficiently small for extirpation with the knife or caustic.

Malformations of limbs.—The malformations resulting from congenital dislocation and fracture will be found described in the next section, by Mr. Brodhurst. Of other malformations of the limbs it seems hardly necessary to say much. Some of them do not admit of any treatment, and are only interesting in an anatomical and physiological point of view, such as the specimens of entire absence of bones and limbs;[1] while in others the only question is whether the patient would be more comfortable with or without amputation. In the upper extremity the chief question will be as to the power of motion and prehension in the malformed hand, or claw, as the case may be; in the lower, as to the feasibility of adapting a stump to the part before or after amputation. It is therefore but rarely that amputation would be recommended in the upper limb, while in the lower it is often, if not usually, advisable.[2]

There are other deformities which may be produced by the pressure of the fœtal cord in utero, and in which, though the limb has not been amputated, it is distorted in various directions, and deep grooves are marked upon it where the muscles appear to have become atrophied.[3] If any treatment can be available in these cases, it must be directed to bringing the limbs gradually into natural position by pressure appropriately directed, and by passive motion, and at the same time stimulating the muscles by friction, liniments, etc.

Polydactylism.—The most frequent malformation about the limbs, and one of the most common in surgical practice, is what is called polydactylism; that is to say, supernumerary fingers and toes. Instances in which a more or less perfect additional thumb exists are very often seen in our hospitals; and numerous examples prove that the defect is often hereditary. It is advisable to remove supernumerary thumbs or fingers early, since they are only in the way; but in doing so some little care is required, as the supernumerary digit often shares in the articulation of the natural one to its metacarpal bone; so that if the whole of the last phalanx of the supernumerary

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of Children's Diseases, p. 270 et seq., where several very interesting cases of hermaphroditism of various kinds are collected.

[1] It might be worth while to remind the reader, in passing, that though probably all nævi owe their origin to some congenital condition, yet they are often, perhaps usually, not noticed till a short time after birth.

[1] For an extreme example, see a case figured in Path. Soc. Trans., vol. x., p. 308, where all four limbs were entirely absent; and the child (who had attained the age of five and a half, and was healthy and intelligent) consisted of a head, neck, and trunk only. Most of the leading forms of these general malformations of the limbs are figured in M. Larcher's work, already referred to; where will also be found drawings of the instruments which have been adapted to such patients.

[2] See a case and drawing by Mr. Lonsdale, Path. Soc. Trans., vol. iii., p. 464.

[3] See a case by Dr. Little, ibid., vol. i., p. 331.

digit were removed, the natural joint would be laid open, and ankylosis might result, which would leave the finger or thumb stiff and extended; therefore the part must be carefully examined, and if even a doubt exists, the phalanx should not be entirely removed, but, flaps having been cut long enough to cover it, it should be divided with bone-nippers near its articulation. No deformity will be perceptible when the child grows up, as the little piece of phalanx left behind will not grow, but will be buried in the soft parts when the hand has attained its full size.[1]

Supernumerary digits, which are seated upon perfect metatarsal bones, are also often attached to supernumerary bones in the tarsus itself; while others are attached to bifurcated extremities of a single metatarsal bone. In some cases the superfluous finger or toe is attached by a thin fold of skin to the continuity of the natural digit, quite away from the joint. In these cases the superfluous digit is rudimentary.

Two cases at least have been put on record in which a double hand existed: one by Mr. Murray, of Brighton, in the Med.-Chir. Trans., vol. xlvi., p. 29; the other by M. Giraldès, in his Leçons cliniques sur les Maladies chirurgicales des Enfants, p. 42. In both cases the bifidity appears to have commenced at the carpus, and in both the thumbs were absent. In Mr. Murray's case no operation was performed, the patient (who was a washerwoman) having been first seen at the age of thirty-eight. In M. Giraldès's case, the superfluous fingers seem to have been removed (M. Giraldès merely says, "en 1864 j'ai opéré un enfant qui avait les deux mains réunies en une seule"). M. Giraldès, however, agrees that the operation was unnecessary, since in this case, as well as in Mr. Murray's, all the eight fingers were movable, and the two parts of which the hand consisted could be firmly opposed to each other, forming a very useful member.

In the foot, supernumerary digits are matters of less consequence than in the hand. If there be but one, and that not sufficiently prominent to cause inconvenience in wearing the shoe, or an unsightly breadth of the foot, there can be little motive for interference. Mr. Athol Johnstone has recorded a case in which the remarkable number of nine toes, more or less perfect, were found on one foot; and the reader who is curious in this matter will find there a full account of the dissection of the part after removal.[2]

Webbed fingers is another very common deformity; and (unlike supernumerary digits) it usually occurs symmetrically on the two hands. It is most common between the last two fingers. The same condition is also found in the toes; but it is a matter of no consequence whatever there. In the hand it appears to be exceedingly desirable to remedy this condition if possible; not merely on account of the use of the fingers, but also as a matter of appearance. The webbed fingers often enjoy a large share of usefulness; and the person can soon accommodate himself to his circumstances; but every visible variation from natural conformation is a source of annoyance and hindrance to a child, and should by all means be remedied if it can be done without danger. Of course nothing is more easy than to cut the fingers apart: the difficulty which is experienced is in preventing their growing together again. Various plans have been adopted. The band having been divided completely down to the cleft, the edges of the wound may be brought together down to the apex of the incision, in order to procure union by the first intention. If the edges will not of themselves come together without force, a portion of skin may be transplanted so as to fill up the cleft; for it is in the cleft that the tendency to cicatrization is manifested.

I would on this head call the reader's attention to the following very ingenious operation, reported by Mr. Barwell, in the Medical Press and Circular, April 25, 1866, in a case of webbed fingers—the index, middle, and ring on the left hand—which had already been twice operated on by the usual methods without success.

"I thrust a straight bistoury in a sloping direction from behind forwards through the tissues uniting the index and middle fingers, keeping the blade much closer to the latter, so that, when the whole length of the digits had been separated, so much tissue was left on the forefinger that its edges could be brought neatly together and sewn with wire. The same proceeding was then used at the next interspace, the greater amount of skin being left and sewn round the inner side of the middle finger. Thus, the wounds to be filled up lay on the outer side of both middle and ring fingers, and at the fork or point of their bifurcation. Of these wounds an impress was taken on a piece of paper, and the necessary pieces were cut from the haunch in such wise as to leave a portion of skin between the two excavations, and also so as to enable me to lift up each strip-like piece in a loop while it remained attached at either end. The wound in the buttock was closed with silver-wire, the fingers to be covered were thrust through their respective loops, and first the palmar edge was stitched—a process which required much care and ingenuity—then the dorsal aspect was secured, and afterwards the hand and arm were carefully bound *in situ*.

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[1] See also on this point Sédillot, Note sur l'amputation des doigts surnuméraires. Comptes-rendus des séances de la Soc. de Biologie, sér. 1, tom. v., ann. 1853, p. 145.

[2] Path. Soc. Trans., vol. ix., p. 274.

"The child slept well during the first two nights, on the third pain kept her restless, and on the fourth day I removed the bandage and cut away the skin connections with the haunch. The hand had swollen from position, but only a very small part of the implanted skin had died, the rest was fairly united. It is unnecessary to follow the details of the case further; it did uninterruptedly well, and in a month the hand was healed, and passive motion had begun to render the fingers more mobile."

Another plan is to divide the fingers from each other, and leave the wound to granulate, care being taken to press something like a band of string or metal into the cleft, in order to prevent adhesion there; the foreign body being fastened to a bracelet. Or, which seems the most promising plan, a large metal ring may first be passed through a hole made at the cleft, and worn there like an earring till the sides of the hole have cicatrized. After the posterior angle of the wound is thus secured against the formation of adhesions, some one or other of the above plans may be adopted with better prospect of complete success. But even if the adhesions do form to some extent, and so render the fold between the fingers deeper than natural, this is a much less conspicuous defect than the former, and besides is not irremediable by further operation.

M. Giraldès has succeeded in dividing these webs by means of a kind of entérotome applied to the web, and gradually tightened, so as to destroy the web in about a week. An instance of the use of this method will be found in Giraldès' Maladies chir. des Enfans, p. 507.[1]

Hypertrophy of the limbs occurs, as far as I can judge from the limited number of cases which I have seen and met with in books, from two causes, viz., from disease of the vessels, or from a congenital tendency much allied to, if not identical with, that which produces the more limited and striking hypertrophies spoken of below as "congenital tumors." In the former class of cases the diseased action results in changes analogous to those produced by chronic inflammation, and similar to those which follow chronic inflammation (though only rarely) in the long bones. Thus I have seen in a case of diffused venous nævus (or rather diffused enlargement of all the vessels of the limb, including the veins), the whole leg become larger, harder, hotter, and longer than its fellow, as it is occasionally noticed that the tibia, in chronic inflammation, outgrows its healthy fellow.[1]

The hypertrophy may affect the whole limb, or only a portion of its length (always, I believe, the lower part), or a part only of the foot or hand, or, finally, only one or more digits.

I do not wish here to speak of the hypertrophy which is an occasional, though very rare, symptom of extensive disease of the bloodvessels, but only of the truly congenital hypertrophies. These depend upon no known cause;[2] and although some of them have been found to be complicated with hypertrophy of the walls of the veins, the latter can have no causal relation to the affection. The congenital hypertrophies may be divided into the symmetrical and the unsymmetrical.[3] In the former, all the parts of the limb are in due proportion; so that there is nothing unnatural about it beyond its gigantic size. In the latter, the parts are variously deformed by large fatty excrescences, and by over-development of the joint-ends of bones, leading to unnatural position or dislocation of one or more joints. Prof. Busch believes that this unnatural condition of the joint-ends is connected with some morbid growth of the epiphyseal cartilage. It leads to irregular enlargement of the articular ends, something like what is seen in rheumatic arthritis; but such enlargement is no necessary accompaniment of overgrowth of the bones. Busch himself has figured (p. 185) the skeleton of a foot in which the bones of the three middle toes are greatly elongated, but all the portions of the elongated bones are in perfect proportion.

The temperature of hypertrophied limbs varies in different instances. In most cases it is normal; in two referred to by Busch it seems to have been diminished,[4] and in one only increased.

The simple hypertrophy of the cellular and adipose tissues of a limb does not necessarily include any change in the muscular or bony framework. It is strikingly like the ill-defined hypertrophy which often accompanies and surrounds congenital tumor.

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[1] On the subject of webbed fingers, and all the other deformities, congenital or acquired, of the fingers, I cannot do better than refer the reader to M. Fort's thèse de concours, "Des Difformités congénitales et acquises des Doigts," Paris, 1869.

[1] See DISEASES OF THE BONES, Vol. III., p. 122.

[2] It may be remarked that only in a very few of these cases has any hereditary predisposition been traced.

[3] I would refer the reader to Busch, in Langenbeck's Archiv., vol. vii., p. 174, for a very full account of this subject.

[4] Mr. Curling's case in Med.-Chir. Trans., vol. xxviii., p. 337, and Wulff's in Petersburger Med. Zeitschr., 1861, 10 Heft.

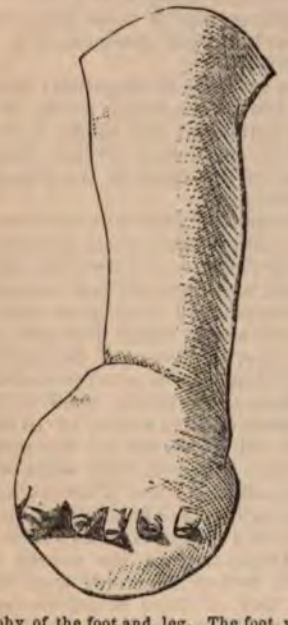
The annexed figure was drawn from a case of the kind. The patient was a child eight months old, in whom the left foot and leg, nearly as high as the knee, were larger than the opposite, and in whom the enlargement of the foot was so inconvenient that, as it was on the increase, the foot was amputated. Anatomical examination showed that the increase in bulk was due only to an unusual deposition of fat and cellular tissue, the muscles as well as the bones being normal.

The amputation of the foot, in this instance, still left the leg considerably larger than its fellow; but when I last saw the child, the limb was steadily diminishing in size under the influence of pressure. I believe that the amputation had been performed under the idea that the disease was of a malignant nature; but the congenital history and the uniform enlargement are symptoms which sufficiently mark the nature of the disease, and exclude all probability of cancer.

Treatment.—In cases where the limb is increased in length as well as in bulk, nothing of course can be done beyond the use of a high sole on the normal foot, unless amputation is thought to be indicated; but where the increase is only in bulk, and is due chiefly (or, as far as can be ascertained, solely) to the enlargement of the cellulo-adipose tissue, much good may be anticipated from carefully-regulated pressure. I have seen a case in which the use of an elastic stocking much diminished the size of the limb; in fact, without it the boy could hardly move about freely: and in the case here represented, where amputation of the foot was performed, the benefit derived from strapping the leg was very marked. As to amputation, I own that I should long hesitate before resorting to so extreme a measure. We know that congenital tumors sometimes disappear spontaneously—why not congenital hypertrophies? especially if assisted by judicious pressure. Besides, the affection is in no degree dangerous to life; nor does it make any very perceptible impression on the general health. And, although a child's gait is awkward with an unnaturally heavy and cumbrous limb, it is, after all, as good as with a wooden leg. As to internal remedies, the liquor potassæ may be tried; but I should not expect much from its use. I should not be indisposed, in a case such as that figured above, to try the effect of tying the main artery of the limb.

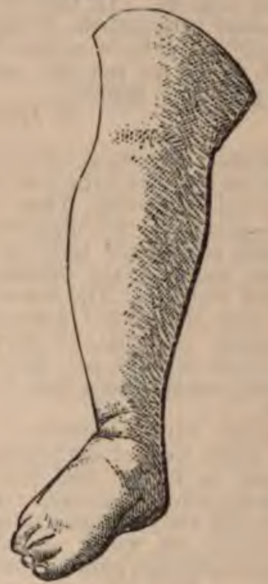
When the hypertrophy affects only one

Fig. 954.



Hypertrophy of the foot and leg. The foot was amputated on account of hypertrophy of the subcutaneous and adipose tissue.

Fig. 955.



Normal leg of the same patient.

(From casts in St. George's Hospital Museum.)

or more of the fingers or toes, the question of amputation presents itself in a different point of view. In the foot it is usually advisable to remove the hypertrophied toes as early as possible. In the hand, the surgeon must carefully consider whether the member will be more useful with its gigantic fingers or without them.

In the unsymmetrical hypertrophy, on the other hand, amputation is, as a rule, advisable in the early stage of the disease. As the limb grows, distortion and deformity will surely increase. And when the malformation is complicated by the formation of large cellulo-adipose tumors, or lipomata, on the hypertrophied parts, the operation is still more urgently indicated.

The malformations resulting from the absence of bones or other parts are in the province rather of the instrument-maker than the surgeon. All that can be done is, by some arrangement of splints and India-rubber bands, to replace the parts wanted, as far as can be; and this is hardly possible in infancy.

T. HOLMES.

Congenital dislocations.—Certain dislocations are found at birth, and are therefore termed congenital. These luxations occur especially at the hip-joint. Other joints also are affected, however; such as the knee, the wrist, the shoulder, the elbow, and the jaw. The last-mentioned dislocations are always connected with monstrosity, paralysis, or alteration of the articular surfaces, and they are more frequently sub-luxations than true dislocations.

Together with anomalies of organization every form of congenital dislocation may be found; and also without monstrosity some irregularities of position occur which are sometimes treated of as dislocations, but which are slight displacements through paralysis or muscular retraction. Such are congenital dislocations of the shoulder.

These are not true dislocations, but partial displacements with paralysis, approximating more or less in appearance to true dislocations; they are perfectly reducible, and are induced through injury at birth. The example which was adduced by M. Gaillard was probably of this description. The title under which the case is given runs thus: "Observation de luxation congénitale de l'humérus, réduite au bout de seize ans."[1] Bouvier, who had to report on it, considered that the dislocation was not truly congenital; but the result, he said, was extremely remarkable, the dislocation having existed for fifteen or sixteen years.[1]

It cannot be doubted, on reading the case as given by Gaillard, that this lesion was not a true dislocation, but that the displacement was due in the first instance to paralysis, and that it was subsequently somewhat increased through muscular retraction. The removal of such forms of paralysis and consequent displacement is not so rare that a single fact of this nature should have been thought worthy of a place in the Mémoires de l'Académie royale de Médecine.

Congenital dislocations of the knee are sub-luxations, which require to be treated as contractions, namely, by extension of the limb after subcutaneous section of the ham-string tendons.

Excessive flexion of the wrist and elbow are by some understood as dislocations. These positions are due, however, to muscular retraction alone. Congenital dislocations of these joints are always connected with malformation or monstrosity.

An instance of congenital dislocation of the jaw is recorded by R. W. Smith.[2] The individual was idiotic, however.

Without further preface, then, dislocations of the head of the femur may be considered.

Congenital dislocations of the head of the femur occur in three directions, namely, upwards and outwards, directly upwards, and upwards and forwards. The first-mentioned variety, or that upwards and outwards, alone demands attention; the other two forms of dislocation having only been seen in fœtal monstrosities.

Dislocation of the head of the femur upwards and outwards, on to the dorsum of the ilium, occurs for the most part as a double luxation, both sides of the body being affected; and it occurs much more frequently in the female than in the male. Thus of twenty-six cases which were seen by Dupuytren in the course of twenty years, two or three only were single, and only four of these luxations occurred in males.[3] Of twenty cases which have come under the author's care, sixteen were double luxations, and thirteen of these occurred in females, while in one boy and three girls the dislocation was single.

This affection is supposed by some to be hereditary. The belief rests on the statement of Dupuytren,[4] which, however, is insufficiently supported.

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[1] Mémoires de l'Académie royale de Médecine, tom. ix., p. 702 1841.

[1] Bulletin de l'Académie royale de Médecine, tom. v., p. 295.

[2] A Treatise on Fractures, etc., chap. ix., 1847.

[3] Leçons orales de Clinique chirurgicale, tom. iii., art. 8.

[4] Op. cit., p. 217.

The *causes* of this dislocation have excited considerable discussion, and various theories have been propounded in support of the different views which have been advanced. This subject has been considered especially by Palletta,[1] Dupuytren,[2] Pravaz,[3] R. W. Smith,[4] Jules Guérin,[5] and Carnochan.[6]

Disease within the articulations of the fœtus is supposed by some to give rise to dislocation. Diseases of an inflammatory character occur in the fœtus, and among others, synovitis, both gouty and syphilitic. It cannot be doubted that, effusion taking place within the joint, dislocation might occur. Proof is wanting, however, that this has absolutely taken place; yet this view, which originated with Ambroise Paré, finds supporters in Sédillot, Malgaigne, Gerdy, Parise, and others.

Again, it has been thought by Breschet and others that arrest of development is the cause of these affections. But Cruveilhier tells us that he has found both the head of the femur and the cotyloid cavity progressing to their normal development in cases of this dislocation. He speaks of these luxations, however, as *vices de conformation*, and he represents in his first plate a full-grown fœtus, with club-hands and club-feet, and with congenital luxation of the heads of the thigh-bones, without testes and kidneys, and with other deficiencies. In this instance the ligamentum teres existed; the heads of the thigh-bones were flattened and deformed, and the cotyloid cavities were shallow.[7]

Original defect in the organization of the germ was the theory propounded by Dupuytren to explain these lesions; and he suggests that, considering the perfect health of these infants at birth, and the absence of disease, either past or present, of the head of the femur or in the cotyloid cavity, this hypothesis is necessary to account for the luxations. It receives no support, however, from physiological facts, nor from the consideration of the laws which govern the evolution of the embryo.

Carnochan supposes that "a pathological spasmodic retraction of the muscular tissue, resulting from a perverted or disturbed condition of the excito-motor apparatus of the medulla spinalis," gives rise to this displacement. He continues thus: "Congenital displacements occurring at the ilio-femoral articulation result from active morbid muscular retraction; that morbid muscular retraction itself is to be traced to a morbid condition of the central ganglionic mass of the cord; and this pathological condition is either located in the ganglionic mass, or conveyed thither by the incident-excitor nervous influence of the excito-motor apparatus of the medulla spinalis."

External violence has been thought to be a cause of congenital dislocation since the time of Hippocrates. It has been shown that external violence may occasion fracture in utero;[1] and Carnochan believes that it will produce fracture rather than dislocation.

Considering the position of the fœtus in utero—that the thighs are flexed upon the abdomen, and that the heads of the thigh-bones must therefore press upon the posterior and inferior portions of the capsule of the joint—it may be inferred that external violence, with or without spasmodic muscular action, might cause the head of the femur to pass from its shallow acetabulum.

Under these circumstances extension of the limb at birth alone is required to displace the bone upon the dorsum ilii—the external iliac fossa being the ultimate position of the head of the femur in congenital luxation. Again, violent or sudden traction at birth may doubtless induce this form of luxation; and it is probable that congenital luxations with perfect development of the head of the femur and the cotyloid cavity are thus produced, some impediment having occurred to delay the completion of the birth.

This dislocation never occurs except with a preternatural labor; and it occurs especially together with a presentation of the nates. When the breech presents, the child passes through the pelvis with the legs doubled up and the feet towards the thorax. The blunt-hook or the finger may be used to assist the passage of the child; and for this purpose it is inserted at the angle formed at the top of the thigh. But traction in this position necessarily increases the pressure of the head of the thigh-bone against the inferior and posterior portions of the capsule of the joint, and readily further displaces the femur and causes the head of the bone to escape from its shallow acetabulum.

The *symptoms* of this form of dislocation differ as the age at which the lesion is observed differs. At birth it passes unobserved. And, indeed, there is nothing to attract attention to the displacement:

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[1] De Claudicatione Congenitâ.

[2] Op. cit.

[3] De la Curabilité des luxations.

[4] A Treatise on Fractures.

[5] Récherches sur les Luxations congénitales.

[6] On Congenital Dislocations.

[7] Anatomie pathologique du Corps humain, tom. i., p. 1.

[1] Med.-Chir. Trans., vol. xliii., art. 8.

it is painless or, if not entirely painless, it is not observable, for the direction of the limb is not sensibly altered, and the motion of the head of the bone is free. Doubtless if the limb were examined with a view to dislocation, the displacement would be discovered.

When the child is lying down, the head of the femur is very slightly prominent; it may be distinctly felt, however, on rotating the limb. In the erect position the head of the bone becomes prominent, and presents visibly on the dorsum of the ilium above and behind the cotyloid cavity.

When the dislocation is double, the pelvis is rendered very oblique, the pubes being carried backwards and the sacrum being raised; the abdomen is prominent and the lumbar region is remarkably hollow—lordosis; while, for the sake of equilibrium, the shoulders and upper part of the trunk are thrown back. The trochanters project abnormally and approach nearer to the crests of the ilia than in their natural condition, and the heads of the thigh-bones can be seen projecting on the ilia beneath the glutei. These several points are well shown in the opposite woodcut.

The muscles of the lower extremities, from insufficient use, are small; the thighs have an inward direction, constituting in some cases genu valgum; while the feet are thrown somewhat outwards, and the sole of the foot is rendered flat—valgus.

The gait in double dislocation is most peculiar and unmistakable; no other motion is like that which is occasioned by this lesion: it is a rolling motion of the trunk together with double lameness; and yet it is painless and rapid.

When the head of the femur is dislocated on one side only, the limb is shortened, and the toes only are brought to the ground in walking, the heel being elevated. There is much lameness on the affected side, and the limb is smaller than the other. The obliquity of the pelvis is not so great as when the dislocation is double.

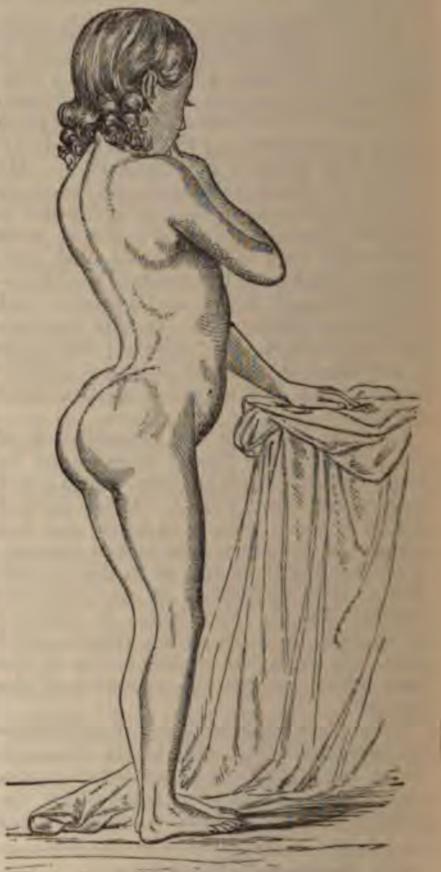
In the recumbent position the lumbar curve is effaced, and the thigh-bone may be drawn down and its head retained against the acetabulum. Shortening of the limb then disappears, and its general appearance becomes normal.

At birth the mobility of the limb is too great. As age advances, deformity increases, and at the same time the hope of restoration of the limb diminishes.

The morbid appearances which are met with in cases of this dislocation vary according to the age of the individual. As has been already explained, only one form of congenital luxation occurs, except with fœtal montrosity, namely, dislocation upwards and outwards. Soon after birth the acetabulum is scarcely altered in shape and dimensions, and the head of the femur also retains its normal appearance. Changes, however, soon take place both of the head of the bone and in the cotyloid cavity, the cavity being filled up with cellulo-osseous material, and the head of the bone being flattened and rendered irregular in form, deprived of its articular cartilage, and atrophied.

The capsular ligament becomes elongated, but it may retain its integrity for many years. At length the head of the femur may escape through its capsule and come into direct contact with the ilium; and, the ligamentum teres being stretched, becomes slender, and finally it gives way.

Fig. 956.



A typical case of congenital dislocation of both hips.

When the head of the bone has passed through the capsule, a false articulation commences to be formed. Thickening of the cellular tissue with deposit of lymph takes place, which is ultimately developed into a new capsule; while a cavity is formed to receive the head of the bone by the deposition of osseous matter upon the ilium.

The *treatment* of this affection in its earliest stage is much more hopeful than is generally supposed.

When dislocation occurs without other abnormality, the acetabulum and the head of the bone are usually perfect at birth. There would then be neither difficulty in reducing the dislocation nor in retaining the head of the bone in the acetabulum. When, however, the dislocation is overlooked and its reduction is not undertaken until several months or years have elapsed, changes will probably have taken place which tend to impede the reduction, and which prevent the head of the bone being retained in the acetabulum. Absorption of the head of the bone proceeds at the same time that the acetabulum is being filled up; while the tissues around the head and neck of the femur are undergoing degeneration, those which are stretched undergoing fibrous degeneration, those which are relaxed becoming weak and fatty, and those which are much exerted, hypertrophied.

At birth the diagnosis can only present a certain difficulty when the luxation is double. When it is single this can scarcely occur; for the difference in the length of the limbs, and especially the difference which exists on the two sides of the pelvis, will discover the dislocation.

Generally, however, the dislocation is only discovered when the child begins to walk. Then the peculiar gait—the lameness when the dislocation is single, and the rolling movement of the trunk when both thigh bones are displaced, is certain to attract attention.

All the peculiarities of this dislocation are exaggerated when the patient is standing, and especially in walking; while, on the other hand, they are much diminished in the recumbent posture. It is for these reasons that congenital dislocation of the femur is seldom discovered until the child begins to walk alone; then the peculiar gait attracts attention.

There was lately under the author's care, in St. George's Hospital, a case of this description, in which the peculiarities of this dislocation were very strongly marked; for the boy was tall, and the trunk and upper limbs were largely developed. He was sixteen years of age.

In this instance both limbs were dislocated, and the trochanters projected abnormally and approached nearer to the crests of the ilia than in their normal condition. The pelvis was thus rendered very oblique, the abdomen protuberant, and the lumbar and lower dorsal vertebræ were curved forward in a remarkable manner. The heads of the thigh bones could be seen lying on the ilia and projecting beneath the glutei. In consequence of the position of the heads of the thigh bones in this as in all these cases, the knees are directed inwards and the feet become flat; and on account of the limited motion of the lower limbs, they remain weak, the muscles being insufficiently developed. While this is the invariable condition of the lower limbs in these cases, the muscles of the arms and of the upper part of the trunk become largely developed, for they are much used in progression; and in the instance to which I now refer they were like those of an athlete, and, as compared with the lower limbs, presented a remarkable contrast.

This boy was not admitted into the hospital with a view to treatment, for those changes to which reference has already been made were to a great extent complete; but before this period has arrived and while the cartilaginous surfaces retain their integrity, the dislocation may be reduced, and the head of the bone retained in the acetabulum. It is probable that this may always be accomplished by manipulation under chloroform prior to that state of muscular retraction taking place which is at length the necessary result of displacement of the limb. When, however, muscular retraction has taken place, although the length of the limb may possibly be restored by drawing down the head of the femur to rest on the acetabulum, it is hopeless to endeavor to retain the head of the femur in the cotyloid cavity, without in the first instance dividing subcutaneously those muscles which tend to displace it. These muscles are those which are inserted into and about the trochanters, especially the glutei and the rotators. When these have been divided subcutaneously there is no further tendency to displacement of the head of the femur. This is the case even when a retentive apparatus is not immediately applied to the limb; but, after its application, subsequent displacement is most easily prevented. After a period of some weeks, consolidation takes place about the head of the bone, which tends to hinder displacement. Then passive motion may commence. It is necessary to continue the use of retentive apparatus for many months without cessation.

As an example, a case may be cited in which this operation was performed on December 2, 1869, with Mr. Whaley, on a boy four years of age, whose right femur was dislocated. This child walked with help and a sustaining apparatus in the following May, and in June he was able to walk alone, and without the slightest displacement of the head of the femur taking place.

Fractures in utero.—Intra-uterine fractures of the long bones are rare. They occur, however, both as simple and compound fractures. Montgomery has placed on record the following instance: "I saw," he says, "a woman, eight months pregnant, fall (from a window) twenty-five feet, into the stony street, on her face. Her hip-joint was dislocated, and her face and hands were cut; but the uterus was not ruptured. She was delivered that night of a dead child, which had some of its bones broken, and which had sustained several other injuries. She recovered perfectly."[1]

Fractures of the fœtal skull have been frequently observed: numerous cases are on record. These are for the most part incomplete fractures, where the bone becomes bent; and they are produced by the pressure to which the head is subjected in its passage through the pelvis; or they are occasioned by the mechanical force of the forceps of the accoucheur.

There is also another class of cases which has attracted considerable attention, and which is mentioned by authors under this title of intra-uterine fractures—solutions of continuity, namely, occurring in a cartilaginous or very imperfectly ossified skeleton. This condition is, however, now known as congenital rickets; and it is a condition differing so widely from that of fractures in utero, that it will only be necessary to allude to it. Grätzer, Mansfeld, Amand, Barker, Chaussier, D'Outrepont, and some others, have directed attention to these solutions of continuity.

Among fractures in utero, those cases which offer the most interest are fractures of the long bones, whether simple or compound, in which reunion more or less complete is observed at birth; or where other proof exists of the fracture having taken place prior to the commencement of parturition; fractures, consequently, not only occurring in utero, but which have not been produced by manipulations of whatever kind during the period of parturition. Such cases are recorded by Ploucquet, Kopp, Devergie, Carus, Schubert, Sachse, and Moffat. For the cases themselves, I must refer to the Medico-Chirurgical Transactions, vol. xliii., 1860, art. 8. In one instance, the fractured extremity of the bone appeared in the wound; the periosteum was destroyed, and the lips of the wound were pale and flabby. In another, the bone protruded fully an inch, and it was carious. In a third case, the uterus was wounded, and blood escaped per vaginam. The fracture had reunited at birth, and the leg was one inch and three-fourths shorter than the other. The following outlines of cases, which I saw together with Dr. Gream and with Mr. Gardner (which are also related in the paper above alluded to), are not without interest.

In the first case, it was observed, at birth, that there was considerable swelling about the right knee, which at length terminated in abscess. There was also a second swelling at the upper part of the thigh; but this subsided without breaking. At the knee, however, it was found, as the swelling subsided, that an abnormal condition of the bone existed. The leg could only be partially flexed, and it could not be fully extended. The extremity was both shorter and smaller than the other.

It appeared in this instance that there had been a fracture through the epiphysis by which the inner condyle of the femur was broken off. The condyle projected in front of the shaft of the femur, and it had been rotated outwards.

In this instance, the mother had fallen downstairs while in the seventh month of pregnancy. She struck the abdomen in falling, and was much hurt. Uterine pains were felt, but they passed off, and the child was not born until three weeks after the accident.

In the second instance, I saw the child some few hours after birth. It was very small, and so ill-nourished that it seemed very doubtful if it could live longer than some few days. The trunk and head were well formed; but the extremities were not in a normal condition. There had been a compound fracture of the tibia in each leg. The fractured bones had reunited somewhat irregularly, the lower portions having been drawn upward, and the flesh-wounds had not closed. The ulna was wanting on either side, and the lower portion of the fibula was also wanting in each leg. The hands and feet were deformed, and there was double talipes varus.

In this instance two accidents had occurred: one during the fourth month of utero-gestation, when the mother narrowly escaped being precipitated into a deep ravine; and secondly, she suffered a severe succussion in a railway train, six weeks before giving birth to the child. It is probable that the first accident may have occasioned the malformation, and that the railway accident may have produced the fractures.

The *causes* of fractures in utero are twofold. They are induced, on the one hand, by pressure, such as is made by the forceps of the accoucheur; and, on the other, by muscular action; and it is probable that these are the only forces which can act on the fœtus in utero to cause fracture, except in such an instance as that which is related by Montgomery, where the effect of *contre-coup* may well have operated to produce fracture. So long, however, as the membranes remain unruptured, it is impossible to produce the effect of contre-coup on the fœtus; neither is it possible that the walls of the uterus shall compress the fœtus to produce fracture so long as the liquor amnii remains to distend the membranes; and we must, therefore, believe that in these instances of fractures of the long bones the fracture has been produced by the sudden and violent action of the muscles of the limb itself.

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[1] Exposition of the Signs and Symptoms of Pregnancy, case 42, p. 680, 2d ed.

Malformation doubtless favors both fracture and distortion, as was clearly the case in the last instance which I have quoted; for here the muscles acting irregularly, through the partial absence of their bony attachments, their opponents readily distort the limb. And the same argument holds good equally of fracture as of distortion; the muscles of the limb acting suddenly and violently on a malformed limb may readily fracture the bone.

The *treatment* of these accidents scarcely requires separate notice; for the bones, at this early age, are so soft and pliable that they may be easily moulded into almost any form. It will sometimes be found, however, that in straightening the bone, however slowly it may be done, the muscles of the limb are rendered rigid; and it becomes necessary, in order to avoid injury to the soft structures, to divide the tendons of those muscles which are rigid —those muscles probably which, by their powerful contractions, have induced the fracture. After division of the rigid tendon or tendons, the limb is readily brought to its normal form by the use of bandages and pliable splints.

BERNARD E. BRODHURST.

Injuries in childhood do not require notice here, since each injury has been already made the subject of a separate description. All that need be said is, that injuries, both wounds and fractures, and particularly their combinations into compound fractures, are more hopeful in the child than the adult, that they heal more rapidly, and that amputation is less necessary.

Congenital tumors and tumors in childhood.—Tumors in childhood do not differ essentially from those in more advanced life, but are usually of looser structure and more rapid growth. Thus malignant disease affects the medullary rather than the scirrhous form; it grows quickly, and proves speedily fatal if left alone, and if extirpated generally returns in a very short time. The eyeball and orbit are its favorite seats, but the bones are frequently affected, and the testicle not uncommonly. The congenital occurrence of cancer is said to have been observed occasionally.[1] Amongst innocent tumors, the softer varieties—fibro-cellular, fibro-plastic, etc.,—prevail over those of more perfect development. Whatever be the presumed anatomical structure of the tumor, its early removal is imperative; not merely on account of the deformity and functional disturbance which it may produce, but also in order to obviate the effect on the nutritive process which is produced by the rapid growth of a tumor. I have had frequent opportunities of convincing myself that the general health improves quickly, and the child begins to gain flesh and strength, after the removal of a tumor which has previously been increasing rapidly. If so, the inference is obvious, that such rapid growth ought to be rendered impossible, by removing the tumor in its stage of quiescence, in every case where this can safely be done; while, if the growth be advancing, the operation is still more urgently requisite.

The chief peculiarities, however, of tumors in early life are observed in those growths which are congenital. Many congenital tumors are formed by single cysts, which sometimes contain clear serum (as in hydrocele of the neck), sometimes dermoid structures (as in the cysts, which frequently present themselves at the upper corner of the orbit), sometimes blood, or fluid exactly like blood (as I have seen in a large cyst occupying the whole thickness of the cheek), and at other times various modifications of serum. Again, other congenital tumors are entirely solid;[2] and although some of them grow rapidly, they have no character of cancer;[3] while others remain stationary for long periods, and then begin to increase.[4] Between these two kinds (the solid and the cystic) there are numerous transitional forms. In the neck, the occurrence of a widely-diffused and rapidly-growing tumor, composed of soft solid, with numerous cysts scattered about it, has often been pointed out;[5] and a similar admixture of cysts and solid substance is noticed in congenital tumors in other parts of the body, where the cellular tissue is lax, as in the orbit

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[1] Walshe on Cancer, p. 146.

[2] See a paper, by the author, on congenital innocent tumors, Lancet, May 21 and 28, 1864.

[3] *E. g.*, the cases numbered 4 and 5 in the paper referred to.

[4] Ibid., case 3; also Mr. Mason's case of congenital tumor of the tongue, Path. Soc. Trans., vols. xv., xviii.

[5] Mr. Cæsar Hawkins, Med.-Chir. Trans., vol. xxii.; Gurlt, Die Cystengeschwülste des Halses, Berlin, 1855.

(see case 5 in the paper above referred to). When formed entirely of solid tissue, this solid is usually of a soft consistence, whitish, and resembling udder on section, not yielding any juice, and consisting chiefly of simple nuclei, with more or less cellular tissue interspersed. The same is also generally the composition of the compound or mixed cystic growths in the neck.

The parts in which these tumors are found are very various. Though most common in the neck, they may occur in any part of the body. Mr. T. Smith, however, in a very interesting paper published in the second volume of St. Bartholomew's Hospital Reports, points out the fact that there is as yet no known instance of a congenital cystic tumor of any of the limbs.[1] But as they have been found in the most various situations—in the back simulating spina bifida, on the surface of the tongue, in the orbit, in the pharynx, and in the internal organs—we can hardly avoid the conclusion either that this is accidental, or that the congenital tumors which occur in the limbs affect the solid rather than the cystic form. There is, I believe, no essential difference between the two forms.

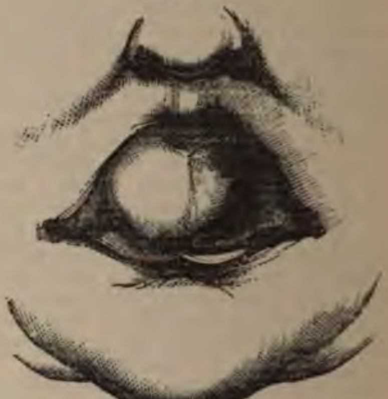
The congenital tumors which are met with immediately beneath the skin and mucous membrane are, I believe, usually solid. This was the case in a patient from whom I removed a congenital tumor developed from the deep layer of the skin of the nape of the neck,[2] and in Mr. Mason's patient, from whom he removed several congenital tumors of the dorsum linguæ.[3] Again, in an infant who died from the development of a tissue of this nature underneath the mucous membrane of the pharynx (probably congenital) which prevented deglutition, I found no cysts in the morbid growth.[4]

The subjoined figure represents a similar congenital growth which I once met with below the mucous membrane of the lip, and which, like the other instances that I have seen of these merely superficial congenital tumors, was destitute of cysts.

In the orbit I have once seen a very singular congenital fibro-cystic growth, which had pressed the eyeball out of the head, leading to its rupture and atrophy, and had then spread some distance on the cheek.

Solid congenital tumors also are sometimes (though rarely) found in the scalp.[1] Thus, in April, 1864, Mr. T. Smith removed at the Hospital for Sick Children a congenital fibrous tumor of large size and lobular form, measuring nearly two inches in one direction by one inch in another, from over the pericranium, to which it was somewhat adherent. It was very hard, so as almost to resemble exostosis in general characters, except that it was movable, and consisted of purely fibrous elements. The patient was a girl of five years of age. The operation was followed by dangerous, I believe fatal, symptoms, which might in all probability have been avoided had the tumor been removed in early infancy.

Fig. 957.



Congenital swelling of lip.

In Mr. Smith's paper some interesting cases will be found of congenital cystic tumors situated in the middle line of the back, and simulating spina bifida. The relation of congenital cystic tumors of the perineum and buttocks to spinal cysts and to included fœtal remains has been discussed above.

As an example of the occurrence of tumors of this nature in the internal organs, I extract the following case from Mr. Smith's paper in the St. Barth. Hosp. Reports, vol. ii., p. 19:—

"A case of congenital cystic disease of the kidney was brought before the Pathological Society by myself for Mr. Marsh.[2] It well illustrates the rapid growth and large size which these tumors may attain. The tumor weighed fourteen pounds, and was removed from a child seventeen months old, whose weight was more than half made up by the disease. It was first noticed at the age of three months, when it appeared the size of an orange. Although from the first the disease made very rapid progress, it was not accompanied by any special cachexia; and until by its size and weight the tumor interrupted the functions of the abdominal viscera, the child's general health was unaffected. When this, however, took place, the child rapidly emaciated, and died of inanition. During life the disease had been diagnosed by Dr. West and others as a renal tumor.

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[1] It is to be noticed that Mr. Smith is speaking of cystic tumor. Mr. Adams relates a case in which Mr. Lonsdale removed a congenital fibro-cellular tumor from the arm of an infant. Path. Soc. Trans., vol. v., p. 327.

[2] Path. Soc. Trans., vol. xii., p. 207.

[3] Path. Soc. Trans., vols. xv., xviii.

[4] Lancet, May 28, 1864, p. 606.

[1] Dermoid cysts of the scalp and congenital sebaceous tumors will be found treated of in the essay on REGIONAL SURGERY.

[2] Path. Trans., vol. xvi., p. 171. Mr. Smith remarks that the growth is here erroneously described as "medullary."

"After death the tumor was found to lie behind the parietal layer of the peritoneum, which was tightly stretched over its anterior surface. It was covered by a distinct capsule, and had formed no connection, either by adhesion or infiltration, with surrounding parts. It originated in the substance of the left kidney. the remains of which, unaltered in structure, were found spread out in a thin layer over its posterior surface. The ureter was healthy; there was no affection of the lymphatic glands; and the remaining viscera were unaffected.

"On dissection, the tumor was found to contain numerous cysts, embedded in a coarse fibrous or reticulated structure. The cysts were of various sizes; the larger ones contained others of smaller dimensions springing from their inner surface. On microscopic examination, the solid parts were found to be of a fibro-cellular structure, the cellular element predominating over the fibrous. The cysts contained a clear serous fluid."

In all these cases I think it may fairly be argued that the congenital "tumor," as for surgical purposes we must call it, is really nothing more than an exaggeration, as it were, of the normal tissue of the part. The polycystic tumor of the neck may be regarded as an enormous development of the natural areolar spaces and of the septa which separate them; so of the orbit, and of the other tumors developed in the loose tissue beneath the fascia in other situations. The solid superficial tumors are thickenings of the corium or of the basement tissue of the mucous membrane; the cystic tumor of the kidney an exaggeration of the natural structure of that organ. Even in Mr. Mason's case of congenital tumor of the tongue, the growths have great analogy to enormously over-developed papillæ. The same may be said of the congenital thickening sometimes noticed in the sterno-mastoid muscle (see REGIONAL SURGERY).

The progress of these congenital tumors, or hypertrophies, is various and very capricious. Sometimes, after attaining a certain size, they disappear spontaneously; a fact of which Mr. Smith, in the paper above referred to, has given numerous examples. Often, I dare say, they remain stationary during life. But at other times, after an indefinite period of quiescence, they resume active growth. Thus in Mr. Mason's case, above referred to, the tumors had been stationary till the age of twenty-seven, when they began to grow rapidly; and Mr. Smith quotes a case from the Revue médicale (March, 1834), where the same thing took place about the age of fifty. In a paper by Mr. Birkett, read before the Royal Medical and Chirurgical Society, June 9, 1868, the reader will find some singular histories of tumors of this kind which obtained a great development towards the end of middle life. Again, they may grow steadily in infancy, drawing into themselves the elements of general nutrition, and thus producing marasmus. It is partly in this way, and partly, perhaps, by mechanical pressure, that the congenital polycystic tumors of the neck so often prove fatal at an early period. Occasionally, indeed, the progress of these tumors is as rapid and as inevitably fatal, if not effectually checked, as that of cancer. Finally, there are some, although these are but few, in which the situation of the mass causes only a slight growth to prove fatal, as in the instance of the tumor behind the pharynx to which I referred above.

The affections from which the congenital solid tumor requires to be diagnosed are cancer, fatty tumor, and degenerated nævus. The cystic tumors require besides to be diagnosed from sebaceous cysts, nævi, and, in certain regions, from spina bifida, meningocele, and included fœtus. From cancer there is little difficulty in distinguishing any except the more rapidly-growing polycystic tumors of the neck, and in these cases their great extent, lobed arrangement, and the great cysts full of variously-colored fluid which they contain, sufficiently indicate their nature to any surgeon familiar with the disease.

From fatty tumor the aspect of the growth, and the absence of the dimpling generally produced by pinching up the skin over a fatty tumor, may distinguish the ordinary fibro-cellular congenital growths. Still it should be remembered that fatty tumors may occur congenitally. Thus Mr. Athol Johnstone has recorded a case of fatty tumor growing congenitally out of the sacral canal, to which reference has previously been made (p. 836). Mr. Gay has related[1] a remarkable case of congenital fatty tumor in the sole of the foot, in which part of the foot was amputated under the belief that "the tumor was of a *recurrent*, if not of a decidedly *malignant* nature," but where it proved to be composed of large meshes of connective tissue, in which were contained fat-cells with margarine crystals in the interior of each. Mr. Gay adds, "the tumor was free of the deep tissues of the foot, and could have been dissected from the skin." Mr. Gay's report of this case is very full and interesting, and is illustrated by good representations both of the external and microscopic characters of the tumor. While saying, therefore, that the more ordinary forms of these congenital tumors require to be diagnosed from fatty tumor, we must not forget that in some rare cases the latter are also congenital.

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[1] Path. Trans., vol. xiv., p. 243.

From degenerated nævus it is often very difficult to make a diagnosis, indeed impossible without an exploratory puncture; and the difficulty is sometimes increased by the presence of nævus-stain in the skin over the tumor, as in my case in the Path. Trans., vol. xii., p. 206. But the diagnosis is not in this instance a matter of much practical moment, since the congenital tumor does not require treatment unless in an active state; and this state of activity would of itself be sufficient to show that it could not be degenerated nævus. From nævus in its active condition these tumors may be distinguished by their wanting that decided change of volume with the respiratory efforts which is always exhibited by large and growing nævi, by their less uniform consistence, and by the results of exploratory puncture. A nævus will bleed copiously on puncture, its tissues will feel soft, and the point of the needle will be almost but not quite fixed. In a congenital tumor, if solid, there will be nothing following the puncture except the minutest quantity of blood, the tissue will feel quite hard, and the point of the needle will be fixed. If the instrument has been plunged into a cyst, a fluid of variable character (but not blood) will run freely out of its groove, and the point of the needle will be perfectly free.

The diagnosis of congenital cystic tumor from meningocele and from spina bifida will be best judged of from the account of these affections. (See also REGIONAL SURGERY.)

Treatment.—A congenital tumor which is not active does not require any treatment at all, unless from its position it be very unsightly or productive of some functional disturbance. It is quite certain that a good many of these congenital hypertrophies disappear as the child grows, and that a further proportion remain without advancing in size for an indefinite period. Still, if the tumor be only small, and the part be one where no danger is to be apprehended, I think it better to remove such tumors at once, in order to obviate any risk in after-life. In larger tumors, where there would be any danger in such an operation, no treatment should be adopted unless the growth is active. If this is the case, the choice lies between several courses. If the solid material be in very large proportion to the cysts (and of course still more if there be no cysts), I believe no measure short of excision will succeed; but there is no objection to the previous use of discutient ointments or lotions, if the case is not very urgent. Mr. Smith speaks favorably of weak vermilion ointment; but I question much whether the cures which have taken place under the use of any of these discutients have not been spontaneous.

When the cystic element is in large proportion, the obliteration of the cysts is the first object, and is often followed by the total disappearance of the disease. In Mr. Smith's paper several highly interesting examples are given of the beneficial effects of small setons in this respect, and some of these examples occurred under my own observation. The remedy is a very simple one, produces little disturbance, and hardly any deformity; and as it is often successful, deserves a trial in any such case. A single fine thread is to be passed through the cyst under treatment, and withdrawn as soon as inflammation commences. After the first seton has produced its effect, a second may be required in another portion of the tumor. I have not myself had any personal experience of this method of treatment, but can bear witness to its success in Mr. Smith's hands. In some cases where the cysts were large and not very numerous, I have seen the best results from iodine injection. Other and more severe measures have been used for the same object, as the prolonged use of large setons in order to obliterate the cysts by suppuration; the introduction of sticks of powerful caustics (the "*cautérisation en flèches*" of Maisonneuve); and the incision of the cysts successively, allowing them to granulate up. These measures should, I think, be rejected. I do not see what object is to be gained by the prolonged irritation of large setons beyond what Mr. Smith effects by the harmless action of small ones; and as to the other two methods of treatment, I have tried them both, but only with the effect of hastening the fatal issue; and I regard them as much more dangerous than total removal.

It only remains to inquire under what circumstances the complete excision of the growth is indicated, and to what extent it is likely to succeed. In the first place, if the growth is rapid, some measure must be adopted to check it, otherwise the infant will either die of the local effects of the tumor (*e. g.*, of pressure on the trachea or œsophagus in tumors of the neck), or from the diversion of the elements of nutrition into the tumor he will fall into a condition of weakness, in which he will soon succumb to one of the customary ailments of infancy. In such a case, if the growth be cystic, and the milder measures before spoken of have failed, or if the growth be solid, so that there is no place for them, I think the tumor ought to be removed entire. In the neck the operation is no doubt a formidable one, because these tumors are always below the cervical fascia, and extend to an unknown distance and in various directions among the important structures of the part; and the nearer the tumor approaches to the middle line, the greater is the danger of meddling with it. But then these multiple cystic growths in the neck are very fatal if left alone; and when they have begun unmistakably to take on active growth, there should be no delay in dealing with them efficiently.

In such instances I believe the operation to be called for by the indications which lead us to recommend the removal of tumors in other parts of the body, viz., the immediate effects of the disease, the prospect of danger from the probability of further increase, and the hopelessness of arresting the disease by other means. But one consideration ought not to be overlooked—that is to say, the fact that in many, if not in all of these cases, the disease is less a new growth in any proper sense of the word than a hypertrophy extending to an uncertain distance among the tissues, and devoid of any demarcation, so that it is very difficult to determine what must be removed and what may be left behind, and equally so to be quite secure that the disease will not sprout up again if any portion has been left.

In order to illustrate this, I will quote the following case, which occurred to Mr. Prescott Hewett. I am not aware that the case has been published by him, but it has been more than once referred to under his authority.[1] A congenital cystic tumor was excised from the posterior triangle of the neck by the late Mr. Keate, in a female infant æt. six months. A small portion of one of the cysts was left, adhering intimately to the subclavian artery. It was not until the age of thirteen that any renewed growth took place, when she was placed under Mr. Hewett's care with a double cystic tumor below the trapezius muscle and the clavicle, as large as the fist. Suppuration was induced in this by means of a seton. This measure was followed by troublesome cough, and finally an abscess broke into the trachea or œsophagus, and she recovered after vomiting a quart or more of fetid pus. She was seen in good health seventeen years after the operation.

This history shows that in a case in which any minute portion of the cyst-walls has been left behind, there can be no security against the ultimate recurrence of the disease. But, if the previous reasoning is correct, this consideration hardly bears upon the question of treatment. We cannot imagine that there is any more security against recurrence after apparent obliteration by iodine injection or seton. The suppuration which follows in the healing of the excision-wound is certainly more likely to destroy such remains of the cyst, or to deprive them of their secreting powers, than the irritation set up by the other methods of treatment. But such considerations are beside the question if the operation is necessary. I earnestly recommend the operation with all its dangers in certain cases—not of course in place of milder measures (injection or seton) when such milder measures have any chance of success—but in place of measures such as caustics and incisions, which, though in appearance milder, are, I am convinced, as dangerous and far less successful.

Congenital or hereditary, and infantile syphilis.—The poison of syphilis, when it has been conveyed into the constitution from an infecting sore, saturates the blood, and vitiates, as it would appear, the composition of many of the secretions, and amongst others of the semen. From the blood, or from the semen, according as it is the mother or father who is the subject of the original disease, the fœtus often becomes impregnated. This gives rise to a train of symptoms in the infant, which strikingly resemble, and strikingly differ from, those of secondary syphilis in the adult.[1]

It is necessary, however, before describing the symptoms of this disease in the infant, to say a few words as to the origin of the disease, and as to the important and very difficult duties which its occurrence in a family lays upon the surgeon.

That the children of healthy women may be born with the constitutional taint of syphilis is so common an observation, that the old idea of infantile syphilis being always, or very often, the result of direct inoculation from a sore existing in the vulva of the mother at the time of parturition, is contradicted by every-day experience, no less than by the character of the disease, in which a chancre is perhaps never, at any rate exceedingly rarely, met with. It is theoretically possible that the child might be so infected; but if that were ever the case, the disease would bear a much stronger resemblance to those unfortunate cases in which surgeons contract syphilitic disease from inoculation of a crack on the finger, during the examination of a venereal sore, than to the ordinary congenital disease here referred to. Still the possibility of such a catastrophe renders it incumbent on a surgeon, when delivering a woman who has a chancre in the vulva, to defend the infant as far as possible from contact with the secretions of the sore, by coagulating its surface with nitrate of silver and coating it with collodion.

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[1] See Mr. Smith's paper, op. cit., p. 21.

[1] The general question of the connection between the hereditary and the more common forms of syphilis will be found discussed in the essay on that subject in Vol. I., p. 207 et seq.

Practically, however, the *congenital* disease, in the proper sense of that word, is always derived from the blood or semen of one or both parents. Therefore when an infant is born, in whom (by the symptoms which will be shortly described) congenital syphilis is diagnosed, it is the duty of the medical attendant to discover which of the parents is affected, and not to allow (if possible) further cohabitation until the secondary symptoms have entirely disappeared, under the treatment which has been already described in the essay on SYPHILIS. Neglect of this precaution may not only entail on the couple the misery of a family of deformed, puny, and ailing children, but to the woman at least is fraught with grave personal danger. Whatever may be the case among the poor, there is no doubt that in the better classes congenital syphilis is usually derived from the father; the mother being uninfected except through the fœtus. Now it has been, if not absolutely proved, at any rate rendered in the highest degree probable, that a healthy woman, carrying a syphilitic fœtus, may become infected with constitutional or secondary syphilis, through the exchange of components which goes on between the fœtal and maternal blood in the placenta. Thus are explained some of those cases in which women, who have never had primary syphilis, have shown all the symptoms of secondary syphilis after living for some years with husbands suffering from secondary symptoms.[1] There seems also some reason to believe that after such an infection of the sound parent, the disease in the future offspring will be rendered more intense. Otherwise the congenital disease appears to become gradually milder in each succeeding child, as the time of impregnation becomes more distant from that of the original infection of the parent, even apart from the influence of treatment on the latter. This, however, is by no means a reason for neglecting such treatment.

Again, children may be infected with syphilis in vaccination, or by contact with syphilitic sores on the persons of their wet-nurses or others. We shall recur to this, more strictly speaking, *infantile* variety of the disease, after having described the symptoms of that which is truly congenital.

Symptoms.—The popular name for this disease—the snuffles—indicates one of its most striking features—a discharge which collects in the nose, blocking it up sometimes entirely, so that the infant is unable to suck for any length of time. In extreme cases, this inability to suck becomes a grave, and even dangerous, part of the disease. The nasal discharge is thought, with great probability, to be due to the presence on the mucous membrane of an eruption analogous to the cutaneous syphilide, which constitutes the principal manifestation of syphilis in the infant.[1] This eruption differs from any of those seen in the adult, most probably in consequence of the different consistence of the skin in early infancy. The spots are usually somewhat coppery, but sometimes of a perfect rose color, and more resemble roseola than any other of the ordinary eruptions; but the eruption is moister than roseola in the adult. On the soles of the feet and palms of the hands the cuticle usually scales off, and the eruption resembles psoriasis. On the other hand, where the cuticle is very thin, and kept moist by the folds of the skin or by discharges (as about the vulva and perineum, near the anus and mouth, or in the groin), flat mucous tubercles are usually met with. Eruptions are also met with in the mouth in the form of white ulcers or patches, displaying the crescentic outline so common in various syphilitic affections of the skin. Together with these symptoms there is also observed, in nearly every case of congenital syphilis, a clear indication of the profound affection of the constitution, in the wizened and shrunken look, the anxious expression, and the dirty hue of the skin (a kind of dirty-greenish yellow), which imparts to the infant a peculiarly repulsive aspect of old age even at the threshold of life. There are other symptoms which are not so often seen. Thus various eruptions are spoken of as occurring in a later stage of the disease. In some severe cases the eruption rapidly runs on to ulceration, crusts cover the ulcers, and a state resembling that of impetigo is produced. Papular and ecthymatous eruptions are spoken of, but they seem only slight variations of the ordinary skin-disease. Whether pemphigus in infants is often, or ever, due to syphilis is an undecided question. I have seen it in connection, at any rate, with congenital syphilis, if not caused by it. The affections of the eyes, of the palate, and of the bones, which are so common in secondary syphilis of the adult, are so rare in children that it is doubtful whether the few cases which occur of disease in these organs in infants during syphilis may not be mere coincidences. I have seen each of these organs affected during the progress of congenital syphilis; but not exactly with the same kind of disease as prevails in the constitutional disease of adult life, *e. g.*, the eye attacked with hypopyon and perforation of the cornea, but never with iritis;[1] large abscesses around the bones, but not nodes or chronic ulceration; sloughing of the soft palate, but not the excavating ulceration of the tonsils, or the caries of the hard palate, so common in mature life. Finally, certain lesions or degenerations of the principal viscera have been pointed out as peculiar to congenital syphilis; but I cannot say that the evidence on the subject appears to me very conclusive; at any rate these lesions are of little moment in practice, inasmuch as no means exist of recognizing them before death.

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[1] Mr. Jonathan Hutchinson, in Med. Times and Gazette, vol. ii., 1856, and vol. i., 1857.

[1] See DISEASES OF THE NOSE, Vol. II., p. 236.

Many of the chronic ulcerative affections of the bones, ordinarily spoken of as strumous, appear to me to be the later manifestations of congenital syphilis; but the history is generally so obscure that it is impossible to form a diagnosis, except by the results of treatment. Thus a child was under treatment for a long time at St. George's Hospital, suffering from caries of the tibia and facial bones. Almost the entire thickness of the tibia had been removed at various operations. Ultimately she came under the care of my colleague, Mr. Pick, who, suspecting the venereal nature of the affection, treated it by means of the mercurial vapor-bath. Recovery was rapid, and I believe permanent.

The period at which the disease makes its appearance is a point of much importance in prognosis. Congenital syphilis is a very frequent cause of the death of the fœtus, and consequent miscarriage of the mother; that is to say, the fœtus is affected at an early period of conception. In other instances the fœtus is born alive, but with the characteristic snuffling and eruption; here the infection has not been matured till a late period of fœtal life. In the majority of cases, however, which become the subjects of treatment, the infant is perfectly healthy, to all appearance, at birth; and the disease first shows itself after an interval, which is commonly about six weeks. As a general rule, the period of the appearance of the disease varies with its intensity; and this, again, varies with the length of time which has elapsed since the first infection of the parent, and depends also on the fact of one or both parents being diseased.

Besides the above congenital or hereditary disease, infants may be affected with syphilis, as adults also may, by various methods of contact and of inoculation. That primary syphilis is communicated by actual contact to any part of the body where an abrasion exists (or probably without abrasion, where the cuticle is very delicate), is a fact of as much importance in the infant as in the adult; and it has been conceded above that possibly syphilis may in some rare cases be so communicated in the act of parturition, and it may also be accidentally inoculated in infancy, as at any period in life, if the patient is brought into direct contact with another affected with primary syphilis, as when a nurse is suffering from primary syphilis. Secondary syphilis, it seems now agreed, may also be inoculated;[1] and this is even more likely to occur in infants than in adults, on account of the constant contact in which they are held to the bodies of those who nurse them, the frequency of slight pustules and abrasions on their bodies, and the thinness and moisture of their skin. This second source of acquired syphilis in infants is verified by many recorded cases.[2] But a third source—and one which, on account of its bearing on public health and public policy, is perhaps even more important—is that inoculation of the vaccine virus, which a wise legislation is now seeking to make generally compulsory in infancy. There seems no possibility of denying that syphilis is in some cases inoculated in vaccination. The facts adduced by Mr. Lee (Vol. I., pp. 209, 210), seem to prove this beyond dispute. It is most consolatory, however, to find that in this country at least this occurrence is so rare that it has never happened in Mr. Lee's own vast experience, nor, I may add, during the many years that I held office at the Hospital for Sick Children did I ever see or hear of a properly authenticated case.[1]

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[1] Sir W. Lawrence, however, speaks in his Lectures on Surgery, 1863, of iritis as a common symptom in infantile syphilis. Having had numerous opportunities of seeing the complaint among the out-patients of St. George's and the Hospital for Sick Children, I cannot remember ever seeing a genuine case of iritis, nor does it occur in the elaborate enumeration of the symptoms of this disease in Diday's work.

[1] See the essay on SYPHILIS, ch. viii., Vol. I., p. 201.

[2] *E. g.*, the celebrated case of Chiabrera, the source of the late vaccino-syphilitic eruption at Rivalta, spoken of in the essay on SYPHILIS, Vol. I., p. 210.

[In volumes fifty-four and fifty-six of the Medico-Chirurgical Transactions, Mr. Jonathan Hutchinson narrates no less than four series of cases in which syphilis was communicated by vaccination. However unpalatable the truth may be, the profession must admit the fact, for not only is Mr. Hutchinson himself in the very first rank as an authority, but a sufficient number of his observations were verified by a committee of the Royal Medical and Chirurgical Society to put their accuracy beyond dispute. When the names of Wilks, Savory, Gascoyen, and Thomas Smith endorse Mr. Hutchinson's deliberate judgment, the facts cannot reasonably be called in question. In the series of vaccinations reported by Mr. Hutchinson, not all those vaccinated from the same children contracted syphilis. Mr. Hutchinson asks whether the practice followed by some vaccinators of allowing the vesicle to drain after its first contents have been exhausted and using the weepings, necessarily mixed with the constituents of the blood, for vaccination, may not account for the fact that those first vaccinated in the series escaped the contagion of syphilis. Whether this is a sufficient explanation is as yet undetermined, but it appears reasonable.

There is, however, a graver question involved than even the possibility of syphilitic infection, one which now threatens the entire community, namely, the disposition to avoid and resist all vaccination on account of the occurrence of such isolated cases as those reported by Mr. Hutchinson. All danger may be averted, where humanized lymph is resorted to, by avoiding cases of first children, and those whose family history is not well known to the physician, and by scrupulous care in the performance of the operation—or if not entirely averted, the danger will be reduced to too infinitesimal proportions to be worthy of consideration. It certainly seems to be a wise precaution to use only virus derived directly from the cow, whenever the surgeon is not satisfied by irrefragable proof of the purity of the humanized virus at his command.]

It appears also, from the experiment related on p. 460 of Mr. Lee's essay, that direct inoculation of blood from a syphilitic patient may propagate primary syphilis. From facts such as these, combined with details of the vaccination performed from the syphilitic infant who was the source of the whole outbreak at Rivalta, and which tend to show that blood was mixed with the lymph introduced, Mr. Lee concludes that the blood, accidentally drawn in vaccinating from this syphilitic child, was the source of the infection; and that to guard against a repetition of such a catastrophe it is sufficient, 1. that a clean lancet should be used; 2. that the lymph should be taken from the vesicles not later than the eighth day; 3. that lymph only should be taken, and that it should be free from the admixture of blood or of other secretions; 4. that the lymph should be taken from a healthy subject. It is greatly to be hoped that these precautions may prove sufficient; and we are encouraged to believe that they may, from the extreme rarity and dubiousness of the occurrence of syphilitic infection after vaccination in this country, as well as from the account of the outbreak in Italy, which shows that it is highly probable that the vaccinator had neglected Mr. Lee's fourth caution; and that if he had carefully examined the infant who was the source of all this mischief, he would have found evidences of existing syphilis.[1]

It will be observed that the *infantile* disease, contracted by contact or inoculation, differs in no respect from the usual forms of primary syphilis, except in the seat of the original chancre, and therefore no more need be said about it here. The importance, however, of knowing, and acting upon, the fact that infants may be infected in this manner, and may then become the sources of contagion to their previously healthy parents or attendants, rendered it necessary to notice the subject.

There are other sources from which an infant may be infected with syphilis while at the breast. It appears to have been now put beyond doubt that the lesions of secondary, as well as those of primary, syphilis are capable of producing the infecting chancre.[2] We may conclude from the facts of every-day experience, that such secondary lesions are not sufficiently contagious to convey the disease, except after prolonged and intimate contact, and to a part where the cuticle is either abraded or very delicate; but there are facts which appear to prove that the infants (in whom both these conditions meet together) do occasionally contract primary syphilis by contact with persons affected with primary or secondary sores. This occurs most usually where they are suckled by women laboring under syphilis (particularly when the syphilitic lesions affect the nipple or mamma), and the part infected is usually the mouth. When, therefore, a child at the breast of a wet-nurse shows symptoms of secondary syphilis some weeks after birth, it will be proper to examine carefully and see whether such symptoms resemble the truly hereditary form of the disease described above, or whether they do not follow on the occurrence of a chancre on the lip, attended by enlarged submaxillary glands. These cases occupy more space in foreign works, probably because wet-nursing is more common abroad than in England; and it appears very usual for wet-nurses to be infected in the nipple by suckling syphilitic infants. In such a condition it is easy to imagine that they might give suck to their own or other uninfected infants, and so a chancre be produced.[1] Nor are cases wanting in which children have been said to be infected in other ways and in other parts of the body.[2] But in all these cases the disease, though differing in its seat and alleged exciting cause from ordinary syphilis, differs from it in no other respect; and an attentive examination will usually clear up all difficulties even at some distance of time from the first appearance of the chancre. The treatment must be the same as for ordinary infecting chancre or its sequelæ.

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[1] A case of vaccino-syphilis was lately exhibited at the Clinical Society, by Mr. T. Smith, in the person of an out-patient at the Hospital for Sick Children. It was, I believe, the first case that had presented itself among the many thousands of out-patients who have been seen there yearly during 13 years.

[1] See op. cit., pp. 183, 184.

[2] On this subject see Rollet, Récherches cliniques et expérimentales sur la Syphilis, and H. Lee, op. cit.

It is perhaps hardly necessary for me to do more than allude in the most cursory manner to the case in which the infants infect the nurse. I have never seen an instance in which this has occurred when the mother has been the nurse, although she might be quite free from any trace of present or past syphilis; but it is impossible to doubt that when suckled by healthy wet-nurses syphilitic infants have often proved the source of contagion. The chancre appears on the areola of the nipple, is accompanied by indurated glands in the axilla, and is followed by alopecia, sore throat, and syphilitic eruptions. Cases of the conveyance of the disease to the husband from women so infected are given by foreign authors; but are to be received as true only after the most rigorous examination—if indeed any examination can entirely justify the assumption.

Diagnosis.—The diagnosis of syphilis in children, whether hereditary or acquired, does not usually present much difficulty. The snuffles, eruption, and peculiar cachexia of the congenital disease, together with its persistence, are usually sufficient to characterize the complaint, even when its history is concealed or unknown. Non-syphilitic roseolous, or other eruptions, might no doubt occur together with coryza; but such eruptions (and still more the ordinary strophulous affection) yield readily to simple treatment. In a few doubtful cases I have found the child's general condition improve so rapidly under the influence of mercury, that I have no doubt of the propriety of administering that drug when we have good reason for suspicion, but cannot form an absolutely certain diagnosis. In the acquired disease, if seen in an early stage, the appearance of the sores, the enlarged glands which are generally connected with them, and the examination of the mother, nurse, or attendant, will usually clear up the diagnosis. Later on, the eruptions, alopecia, and affections of other organs, must be diagnosed by the same rules as secondary syphilis in the adult; but as the disease is so much rarer in children, more caution will be necessary. In a case of suspected vaccino-syphilis, the points to which attention should be directed in forming the diagnosis are, the state of health of the child from whom the lymph was obtained —if that can be ascertained—the appearance and secretion of the sores, the character of the bubo, and the appearance of secondary symptoms after three or four months.[1]

Prognosis.—The prognosis of hereditary syphilis is usually represented as very favorable, if only the disease be early treated. I must say, however, that I have seen a good number of syphilitic children die; few indeed from the direct results of the disease, but many from intercurrent infantile disorders of various kinds. In fact, congenital syphilis is a profound cachexia, which renders children far less able to resist any of the numerous febrile disorders to which (especially among the lower classes) they are so much exposed. With this reservation, the prognosis is good for ordinary cases; but those in whom the disease has commenced before birth, and who are extremely stunted and withered, will very probably die, more especially if the nose is so much obstructed as to render sucking difficult.

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[1] Rollet, op. cit., pp. 256, 263.

[2] Thus some of the children who nursed the babies infected by vaccination at Rivalta had sores and suspicious eruptions on their arms and other parts.

[1] It would be a question for the surgeon himself to determine whether he would think it justifiable, in the case of a doubtful sore after vaccination, to test its inoculability on another part of the child's body. If the surgeon held, with Mr. Lee and others of the best observers, that an inoculable sore is a soft sore, and therefore non-infecting, and therefore not requiring specific treatment, no practical advantage could result from the experiment.

Treatment.—The only treatment which is at all justifiable in congenital syphilis is the administration of mercury; and the only question therefore is as to the most advantageous way of administering that drug. The method of inunction recommended by Sir B. Brodie is quite sufficient: this is managed by merely keeping a flannel band, smeared with ung. hydrarg. twice a day, constantly applied to the thigh or the arm for about six weeks. This is the most convenient plan in private practice, or where the surgeon can make sure that his directions are implicitly followed; but in hospital practice, I have found it more safe to give the drug in the form of medicine—a plan in which the ignorant have more confidence; a grain and a half or two grains of gray powder, with a little of the compound chalk-powder to prevent irritation, may be given night and morning. The calomel vapor-bath may be used, if the parent or nurse is also infected. Whatever be the form selected, the course should be carried on for full six weeks, by which time the eruption will most probably have disappeared, and the child have regained its plumpness and healthy complexion. If not, the mercury should be continued until the cure is complete.

The local treatment is of subordinate importance. In the essay on DISEASES OF THE NOSE (Vol. II., p. 235), Mr. Durham insists on the necessity of removing foul discharges which may become a source of irritation, and so propagate disease to the nasal bones. Ulcerations about the genitals may be touched with solutions of caustic or sulphate of copper; and the ordinary applications may be used to sores in other parts. But these measures have little real value beyond their cleansing efficacy. With a sufficient course of mercury, simple cleanliness is usually all that is necessary; without it no local applications do much good

The remoter effects of congenital syphilis are either direct or indirect. As the ordinary congenital disease bears a considerable resemblance to the secondary symptoms in adults, so there are seen, although only rarely, phenomena analogous to the ordinary tertiary symptoms. The researches of Mr. Hutchinson on interstitial keratitis, and on the deafness which appears to be sometimes a consequence of congenital syphilis, are well known, and have been alluded to above.[1] Another remote consequence of congenital syphilis which Mr. Hutchinson has pointed out, is the condition of the permanent teeth,[2] the central pair of incisors in the upper jaw presenting the peculiarities of being generally ill developed, usually small in size and therefore separated from each other, of soft consistence, and marked at a short distance from their free edge by a crescentic notch from which one or more tubercles project, so that the edge of the tooth is notched, lobulated, or irregular. These tubercles soon wear off in consequence of the softness of the teeth, leaving the edge of the tooth crescentic. Syphilitic teeth are also very liable to caries; but the irregularities here spoken of exist in those which are not carious, and are far better observed in such. The same or similar peculiarities may be presented by the outer incisors of the upper jaw, by the lower incisors, and by the canine teeth; but they are less marked, and not relied upon as diagnostic by Mr. Hutchinson. Both his papers are well worth reading, and his views have been supported by experience hitherto; although the whole question is so difficult on account of the length of time which has elapsed between the supposed cause and its observed results, and also on account of the nature of the disease, that it is very hard in many cases to say whether they tend to support Mr. Hutchinson's views or not.[3] It is certainly important, in a diagnostic point of view, to be familiar with this alleged syphilitic condition of the central permanent incisors; not to confound it with the numerous other irregularities to which the teeth are liable from hereditary or personal peculiarity, from disease and from neglect; and I may be allowed to add, not to forget that Mr. Hutchinson's doctrine is not intended to apply to the temporary teeth: these, although they may of course be diseased in syphilitic children, do not show any diagnostic peculiarities.

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[1] See DISEASES OF THE EYE, Vol. II., p. 71; DISEASES OF THE EAR, Vol. II., p. 215.

[2] Path. Soc. Trans., vol. ix., p. 449; vol. x., p. 287. See also the illustrations in the essay on DISEASES OF THE EYE, Vol. II., p. 72.

[3] For instance, I had some time since a patient aged about twelve, in whom the condition of the teeth and of the corneæ was strongly indicative of congenital syphilis; he had also lost the soft palate from ulceration: and the very striking improvement which followed the use of iodide of potassium alone, with no other medicine either local or general, strongly supported my first impression that the case was one of tertiary congenital syphilis. Yet I could obtain no account of the original disease; and the occurrence of syphilis in either parent was denied, and with all apparent sincerity.

Finally, there are some other tertiary symptoms which are occasionally seen connected with old attacks of hereditary syphilis, but so rarely that the nature of the connection can hardly yet be said to be settled. Thus I have spoken in the note of a case in which destructive ulceration of the soft palate took place in connection with many of the symptoms of congenital syphilis; in another case I have seen laryngitis, requiring tracheotomy, in connection with interstitial keratitis, total deafness (acquired), and lupus exedens. And in connection with the latter disease (which appears to be, though rarely, a symptom of the later stages of syphilis in adults, especially in hot climates), I may say that I am informed by my friend Mr. Naylor that he has seen a case of vaccino-syphilis where the whole arm was covered by a copious eruption of well-marked lupus. That some of the diseases of the bones so common in weakly children may be due to tertiary congenital syphilis is, as I have remarked above, probable, but I think not yet proved.

The treatment of these later stages of syphilis is pretty nearly identical in children and in adults.

Infantile paralysis.—One of the most lamentable, and often, unfortunately, one of the most incurable, affections of infancy is that form of paralysis which is called "infantile" or "essential" paralysis,and which differs from the forms of palsy which are described in other parts of this work, as well as from those which are the more proper object of the physician's treatment, in the important fact that the palsy is not a symptom of any known disease (as is the case in the progressive atrophy of muscles which is described in the essay on DISEASES OF THE MUSCULAR SYSTEM), nor is occasioned by any lesion of the nervous centres or (as far as we know) of the nerves themselves; but is the essence of the disease.

The palsy, or loss of motion, affects single muscles in some rare cases,[1] but more usually whole limbs (generally the lower), and often the whole of one side of the body. It may even attack both lower limbs, though this is very rare.

This strange affection raises many questions of interest with respect to its causes, its pathology, its diagnosis, and its treatment; as to none of which does it appear that very confident answers can at present be given. In the first place, as to the causes of the essential paralysis of infancy. These can rarely be discovered. In some few cases the affection has followed immediately on exposure to cold, and has affected only the part exposed, as paralysis of one leg after long sitting on a damp stone;[1] but, in the great majority of instances, no hint is obtained from the history of the disease, except that, as most cases come on during the period of the first dentition,[2] there is a vague habit of referring the disease to "dental irritation." But of the real existence of this irritation there is usually no proof, still less of its having had any influence on the nervous centres. Convulsions sometimes accompany the onset of the disease; but they can hardly be regarded as connected with it as a cause, since the form of paralysis we are here speaking of is quite distinct from that which is caused by disease of the brain.

The causes of the disease being unknown, it is not wonderful that its pathology should be so too. It is regarded with much plausibility by some authors as an affection of the nerves; but against this view is to be placed the fact that the palsy does not always (I believe, not often) correspond in extent to the anatomical distribution of the nerves; and that although the nerve apparently affected may supply both muscular power and sensation, the palsy hardly ever affects the latter function, and if it does, the loss (or what is more common, the exaltation) of sensibility is general over the whole limb. Dissection has hitherto thrown no light on the matter. The muscles are of course atrophied from disuse; but neither in the spinal cord nor in the nerves has anything been found to account for the symptoms.

Symptoms and diagnosis.—The diagnosis of the disease can usually be made with accuracy; but some cases will be left, in which it is not easy to separate essential from symptomatic paralysis. The history of a case of infantile paralysis is usually this: The child has been, as far as it was noticed, in its usual health, or perhaps may have had a feverish ailment of some kind, which has left it weak; when, either suddenly or gradually, it loses the power of motion to a greater or less degree. A slight feverish attack may accompany the commencement of the disease, and during this attack there may be convulsions. The loss of power will always be found at first to be partial, and in some fortunate cases is transitory—the affected muscles regaining their strength as rapidly as they lost it—but in the greater number the palsy increases, till the part can be hardly, if at all, moved. To this second stage of the disease, which may last an indefinite time, succeeds one in which deformities are produced by the action of the unparalyzed muscles, in those cases where the palsy affects (as it often does) only one side of a limb. Thus the heel is often drawn up by the unbalanced action of the tendo Achillis, producing club-foot, or the toes are drawn into the sole of the foot; the knees flexed by the ham-string muscles; and I have known a case where the thighs were drawn together by the rigidity of the adductor tendons.[1] During this last stage of the disease the palsy may have more or less subsided in the muscles originally affected.

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[1] I have had two or three cases under my own care, in which the deltoid was the only muscle affected. Sir B. Brodie related a case to Mr. Adams, in which he believed the muscles of deglutition were paralyzed. Is it possible that this was diphtheritic?

[1] West's Lectures on the Diseases of Infancy and Childhood, 4th ed., p. 219.

[2] Out of 32 cases noted by Dr. West, the disease began in 19 between the ages of eight months and three years.

In each of the stages of the disease, the careful study of the symptoms will usually enable a surgeon to pronounce a correct opinion. In the first stage—that of incipient paralysis—the great point is to distinguish the disease from inflammatory affections of the brain, and from disease of the spinal column. In most cases there is little difficulty, since in the infantile paralysis the loss of power is usually limited to a few muscles, and not complete even in these; while in that which is due to organic lesions of the nervous centres the palsy is usually extensive and complete. To this it may be added that the causes of cerebral paralysis in childhood—as meningitis, hydrocephalus, tubercle of the brain—have their own appropriate symptoms, which must be sought for with care, and will be found wanting in the essential paralysis. I have never seen a case which it was possible to confound with spinal paralysis; and should suppose that a moderate amount of care would always suffice to prove the absence of any spinal affection.[2]

In the stage of confirmed paralysis and atrophy the chief point is to distinguish the disease from joint-affection and from progressive muscular atrophy, as well as from the affections of the brain and spine. The latter is usually easy at this stage. As to joint-affections, the question occurs chiefly in the shoulder and hip. In the shoulder there is little difficulty. The arm affected by essential paralysis of the deltoid is relaxed in all the parts around the joint, and the head of the humerus hangs down at some distance from the glenoid cavity, partially dislocated by the weight of the arm itself. There is no pain or difficulty on passive motion. The hip-joint is less easily under observation, and the morbid sensibility which accompanies some of these cases of paralysis gives more resemblance to hip-disease on first handling the limb; but the distinction is usually easy to make. Paralysis generally affects a great part or the whole of the lower limb; hip-disease only causes loss of movement of the part affected: in the former passive motion is easy and causes no pain, or not more than any other motion; in the latter the joint is stiff, and an attempt to move it causes acute suffering, not occasioned by any other movement: finally, in paralysis there is no wasting of the buttock, unless the whole limb is wasted, nor is the position of the trochanter ever altered. From progressive muscular atrophy, or "wasting palsy,"[1] the rare occurrence of that disease in infancy, and its progressive advance, will suffice to distinguish it. In its latest stage, of contraction and deformity, the disease is sufficiently marked.

Treatment.—Infantile paralysis, then, consists in a sudden or gradual loss of power in certain parts, unaccompanied by any inflammation, or by any symptoms of disease of the brain or spinal cord. The main consideration in its treatment is the natural progress of the disease. Some authors take a more sanguine view of this subject, and say that there is a natural tendency to cure,[2] but this seems to me to apply only to milder cases of the disease. In such cases the palsy is often transient, and the usual remedies for any disorder of the health which may be present will get the credit of having cured it; but in confirmed cases (that is when total inability to use any muscle or set of muscles has lasted for several weeks), I cannot say that I have seen much benefit from treatment. In the early stage, while there is some feverish affection, and perhaps a tendency to convulsion, antiphlogistic remedies may be employed, such as purgatives, and the continuous use of mercury.[3] But the internal indications usually point to the use of tonics, among which Dr. West speaks well of strychnia. He says, "I have never yet given it to infants; but with children of four years old I begin with an eighth of a grain of the spirituous extract of nux vomica three times a day, increasing the dose by degrees, to a sixth, a quarter, or a third."[1] In a very interesting paper, recently published in St. Thomas's Hospital Reports, new ser., vol. i., Mr. Barwell speaks well of the injection of strychnia in minute doses under the skin. When all disturbance of the general health is over, but the paralysis persists, local measures afford more hope of cure than general treatment, viz., passive and active movements, stimulating applications, and galvanism. The palsied limbs should be well rubbed and gently shampooed twice a day; the child should be encouraged, coaxed, and if possible forced to use them (for the palsy is not often complete); for which purpose any games that it can be got to take pleasure in, or a baby-jumper, or a go-cart, will be found useful. The linimentum cantharidis has often seemed to me to be of service; and galvanism, if carefully and scientifically used, certainly does good in some cases, though it often fails in others apparently quite similar. In the final stage of the disease, when deformity has been produced by the uncontrolled action of the unaffected muscles, much good may be done by carefully contrived apparatus, aided when necessary by tenotomy.[2] Very often it will be found that the child who has previously been doubled up, and whose limbs have all been rendered useless, can in this way be put quite straight, and enabled to stand with the assistance of supports, and even to walk a little with the help of assistants; but I have not hitherto seen a case of confirmed palsy in which any greater improvement than this was obtained, though I have continued patient treatment by all known methods for many months.

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[1] West, op. cit., p. 228.

[2] I should perhaps mention that cases are recorded in which an enlarged gland or tumor has pressed on a nerve, and caused palsy of the parts supplied by it. In cases of localized palsy, therefore, the course of the great nerves of the part should be examined.

[1] This name is given to it in a treatise by Dr. Roberts, of Manchester, which the reader will do well to consult. The disease in question is described in the essay on DISEASES OF THE MUSCULAR SYSTEM, Vol. III., p. 383.

[2] See a paper by Dr. Bierbaum in Journ. f. Kinderkrankheiten, vol. xxxii.

[3] Gross says, "An early resort to mercury is very important. The best form is calomel, in doses of the fourth of a grain, night and

For an account of the curious disease which occurs in childhood, and in which the muscles are degenerated with apparent hypertrophy, I must refer the reader to Dr. L. Clarke's essay on DISEASES OF THE MUSCLES, Vol. III., p. 385.

Gangrene.—Cases every now and then occur in which gangrene comes on with frightful rapidity, and without any obvious cause, in children—usually those who are debilitated by some previous febrile ailment. Such a case took place some years ago at the Hospital for Sick Children, in the person of a little boy who was convalescent from measles, and about to be discharged. He had made no complaint of any sort, but the nurse in undressing him found both feet black in patches. Three hours before, his stockings had been put on, and the feet were then natural. The child was examined, the case found to be really one of gangrene, and the patient of course put to bed. The gangrene extended with great rapidity, reaching as high as mid leg next day, when he died. There were also patches of gangrene on the elbow and hand. No cause was discovered on post-mortem examination to account for this rapid invasion of gangrene.[1] Such cases are of course very rare; but in two situations gangrene is very common in childhood, viz., in the face, cancrum oris; and on the vulva, noma vulvæ. The former affection has been already described, having been used in the essay on GANGRENE, Vol. I., p. 356, as an illustration of one of its spontaneous forms. The latter form of gangrene is very frequently seen in children's hospitals, though I cannot recall any instance of its spontaneous development in hospital; and from this circumstance, as well as others in its history,—viz., the aspect of the children; the rarity, to say the least, of its occurrence amongst the children of the upper classes; and the success attending its treatment,—it seems pretty certain that it is the direct consequence of bad food and inattention, more particularly if the child has been previously ill: but cases often occur in children who have had no known illness. And the fact that noma may occur independent of any irritation of the genital organs is proved yet more unmistakably by the occasional commencement of noma pudendi far away from the mucous surface, sometimes even in the skin of the groin. In such cases, again, irritation (such as that of erythema intertrigo) may have preceded; but I have seen instances where no such cause was alleged, and where the sloughing commenced in the fold of the groin. Whether the real exciting cause in these cases is glandular abscess may be sometimes doubtful; but I am confident that I have seen cases where the sloughing commenced in the groin, the genital organs being free from disease. The first symptom noticed is usually a dusky color of the skin of the labia, and foul discharge, with pain in micturition. The parts swell, and soon

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morning, continued, with an occasional brief intermission, for several successive months." System of Surgery, 5th ed., vol. i., p. 656.

[1] Op. cit., p. 229.

[2] I quite agree with Mr. Barwell as to the importance of avoiding tenotomy in these deformities from paralysis, whenever the limb can be got into a natural position without operation.

[1] British Medical Journal, 1857, p. 387.

assume a gangrenous color, the slough being bounded by a halo of inflammation extending to the groins. At the same time there is much depression, loss of appetite, and occasionally vomiting. The treatment consists in stopping the extension of the gangrene, supporting the strength, and regulating the condition of the bowels. For the first purpose nothing seems so appropriate and so successful as the application of the strongest nitric acid. This caustic is peculiarly successful in the gangrene of children in all its forms. Sloughing phagedæna in adults often proceeds unchecked after the application of the acid; but in all the cases (which certainly have not been many) that I have seen of its application for sloughing phagedæna in childhood, the gangrene has been at once checked. So also in cancrum oris. Whenever the extent of the disease has been such that it has been possible to steep the whole gangrenous surface in the acid, the disease has been checked. Noma pudendi is not less, in fact it seems to be more, under the influence of this remedy; and there are few cases which will resist its timely and thorough application, if conjoined with the proper measures of general support; but the application must be both thorough and timely. As soon as the disease has declared itself, or as soon as the child is brought under treatment, chloroform is to be administered, the parts well separated by an assistant, and the whole of the sloughing surface freely steeped in the acid. Next day, should any part appear to have escaped the application, or should the gangrene be spreading in any part, that part should be again freely cauterized in the same way. Some surgeons prefer the actual cautery; but I have found the nitric acid so successful, that hitherto I have had no experience of any other caustic. After the cauterization, a poultice should be applied to hasten the separation of the slough, and a lotion of carbolic acid may be poured into, or placed around, the poultice to correct the fetor. A purge may be given at first, if the tongue is foul, and bark with chlorate of potash, or with ammonia, or some other diffusible stimulant, given in as large doses as can be borne—wine and food being allowed as freely as the child will take it. In cases where the general strength is not extremely depressed, and where this treatment is adopted early, it is almost uniformly successful: but in the opposite circumstances, even though the gangrene may be stopped, the child, without any obvious symptoms, will sink and die. No post-mortem appearances are found in such cases. After recovery there appears to be little deformity; but I have had no opportunity of seeing whether any trace of the ravages of this disease persists in after life.

The reader may find in the Lancet, 1850, vol. ii., p. 578, the account of a case under Sir W. Fergusson's care, where the vulva became entirely obstructed by adhesion of the labia majora in ulceration or sloughing following on measles. This is not expressly related as a case of noma pudendi, although perhaps it ought to have been, measles being one of the recognized causes of that affection. In the cases of noma which I have myself seen, the vaginal opening has seemed rather widened than contracted. In noma, however, and all other ulcerative affections in these parts, it is our duty not to lose sight of the child till the surface is soundly healed and contraction is no longer to be apprehended. If contraction is impending or is recent, it may perhaps still be possible to dilate the parts. In case of old contraction or adhesion of the labia, some plastic operation will in all probability be required. In the case referred to, the adherent labia were simply separated, and an attempt made to keep them apart; but the success was imperfect.

Infantile leucorrhœa.—The vagina in children also sympathizes in the child's general condition in another way, which very often falls under the surgeon's notice. This disease occurs as a copious discharge of a purulent or muco-purulent fluid, much resembling the discharge of gonorrhœa, and usually supposed by the child's mother to be the result of impure connection. In the great majority of cases no such connection has occurred, and the suspicion ought to be dispelled from the minds of the parents, as it frequently gives rise to unfounded charges. But in a few cases there is no doubt that a criminal assault has been the source of the disease. No diagnosis, as far as I am aware, can be made between the ordinary infantile leucorrhœa and a gonorrhœal discharge which has been caused by connection unaccompanied by violence,[1] except in some very rare instances in which, the child having been seen very soon after the occurrence, spermatozoa have been detected in the vagina.[2] [The disproportionate size of the male organ must always render actual penetration in these cases extremely rare, and experience shows that for it to be so complete as to rupture the hymen is almost unknown. The surgeon who is called upon for an opinion in such cases should be extremely guarded in pronouncing it. He should invariably insist upon a second examination after an interval of some days, when the pain and swelling produced by violence should have disappeared, which would not be the case were the patient suffering from a form of infantile leucorrhœa.] But if any force has been used, either to compel the child to submit, or in order to effect penetration, the marks of bruising or laceration will afford valuable evidence. The common infantile leucorrhœa comes on with some inflammation of the parts, causing a good deal of itching and complaint in passing water. The labia are swollen and red, and often more or less excoriated. The discharge soon sinks into a chronic condition, and may remain so for an indefinite time. The general health is usually more or less feeble, and the child often suffers from worms. Attention to the state of the general health and of the bowels, fresh air, chalybeates, scrupulous cleanliness, and the liberal use of astringent injections, will usually cure the complaint; but it is often slow in subsiding. Care must be taken in injecting to use a small syringe, and do no violence to the parts; and it is advisable to dry the vulva well afterwards, and to smear some oil or lard over it to obviate the contact of the discharge. If the disease be known or suspected to be gonorrhœal, little variation need be made in the treatment; except perhaps that, as the complaint will commence with more acute symptoms, poppy fomentation may be used for the first few days, and the child kept in bed.

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[1] Mr. Cooper Forster gives a curious case, in which a woman communicated gonorrhœa to two girls by washing them with her own sponge, op. cit., p. 125.

[2] I am told that this occurred in a case at King's College Hospital, a short time ago.

Condylomata are not common in children, notwithstanding the frequency of vaginal discharge. Mucous tubercle is a very common symptom of congenital syphilis; but it is usually under the influence of mercurial applications, combined with the internal use of mercury; in more obstinate cases the acid nitrate of mercury may be required, and is pretty sure to remove the tubercle. It is but rarely that we are called on to treat, in childhood, the large villous masses of condylomata that so often come before us in adults, when the subjects of venereal affections. In children, condylomata may be safely and efficiently treated under chloroform by removal with scissors, and searing the base with the actual cautery; if the growth is at all large, it is far better to resort at once to this radical operation—which gives no pain, or very little, when the cautery-iron is thoroughly applied—rather than to trust to the slower and more painful action of the potential cauteries, though these will succeed in slight cases if combined with the most scrupulous cleanliness.

Tumors of the vagina.—The vagina is in some rare cases the seat of soft tumors, which, if not congenital, are rapidly developed in very early life. A female infant was under Mr. Athol Johnstone's care some years ago, at the Hospital for Sick Children, in whom a bleeding warty growth existed inside the labia, looking somewhat like ulcerating condyloma, but with no syphilitic history. It had been treated by a course of mercury for some months at another hospital, as syphilitic, but got worse. The application of the acid nitrate of mercury effected a cure. In another case under my care the vagina was filled with a large mass of semi-solid matter mixed with cysts, looking something like a bunch of grapes. I pulled away as much as I could, and applied a caustic to the base of the tumor; but whether with permanent success I do not know, as the child was removed from the hospital by her mother. Such tumors may be excised if their attachments render it possible; but even then the free hemorrhage that would be produced is undesirable in infancy. In the case just described it would have been impossible to cut away the tumor, in consequence of the small size of the vagina and the depth from which the mass protruded. Probably caustics would be in all cases the best, and of these the acids or the electric cautery would be the most manageable.

Rickets is a disease peculiar to childhood; for though the effects of rickets are perceptible in the deformity which it produces throughout the whole of life, yet all active symptoms always subside long before puberty. The softening of the bones, which occurs in later life, and to which the name of mollities ossium has been given, is to be distinguished from the infantile malady.[1]

The term "rickets" has reference to the distorted condition of the bones, especially those of the limbs, which is the most striking feature of the disease.[2]

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[1] See Mollities ossium, in DISEASES OF THE BONES, Vol. III., p. 166.

[2] The term "rachitis" was originated by a committee of the College of Physicians (one of whom was Glisson), about 1645. "One of us," says Glisson, "in searching for a name, hit upon that of *rachitis*, which took our fancy immediately." Glisson remarks that the disease which they christened "rachitis" was vulgarly known by the name of "rickets" (hence it follows apparently that the latter term is not derived from the former). Can

This, however, is only a symptom of the constitutional cachexia which is the essence of the complaint. As in syphilitic, cancerous, and scrofulous affections of the bones, so in rickets, the local condition is only the expression, as it were, of a latent and undetermined tendency in the whole organism, which, as in the diseases referred to, attacks other parts as well as the bones. But, unlike those diseases, the affection of the bones is in most cases of rickets a matter of far greater practical importance than that of remoter parts. Accordingly, in the short sketch which my space will allow, I shall dwell more on the local than on the constitutional features of rickets. Those who desire to obtain a more adequate view of this important subject may consult the valuable lectures of Sir W. Jenner, in the Medical Times and Gazette, vol. i., 1860.

The chief symptoms of rickets are as follows: The ends of the long bones and those of the ribs, where they join on to the epiphyses or the costal cartilages, are noticed to become swollen and knobby. This enlargement is particularly perceptible in the carpal ends of the radius and ulna. Soon the limbs become weak, so that sometimes, if the child has begun to walk, it is "taken off its feet;" or else the power of walking is not attained at the usual time; in other cases the child continues to walk, but at the expense of increasing deformity of the extremities, producing bow legs, and deformity of the spine, causing one of the species of curvature. This deformity is a consequence of a peculiar process of softening which goes on in the shafts of the bones. The morbid anatomy of rickety bones has been described with great minuteness by the German anatomists, and in our own language in the excellent lectures of Sir W. Jenner.[1] It will be sufficient here to say that the chief changes are a large production of growing tissue at the epiphyseal ends, a softening of the bony tissue of the shafts, attended with enlargement of the lacunæ, which are occupied by a red pulpy substance, and a great thickening of the periosteum.[2] In the flat bones, especially those of the cranium, a considerable increase in the thickness of the whole bone results from this thickening of the periosteum and enlargement of the lacunar tissue, and the large size of the head generally noticed in rickety children is due partly to this thickening of the cranium. The softening of the bones soon reaches such a degree that the bones bend under the influence of external force and of muscular movement. The extent to which each of these mechanical causes influences the curvature of the limbs, of the chest, and of the spine, is a matter of much interest, and of some importance in practice. As to curvatures of the spine and as to pigeon-breast, the reader will find all that is necessary in the section by Mr. Shaw on those subjects. Rickety curvature of the limbs is, no doubt, produced by both causes. Where powerful muscles (as the deltoid) are inserted at an advantageous angle into the shafts of the long bones, deformity is generally very marked in advanced rickets; while on the other hand, the deformity is as marked in situations, such as the forearm and the tibia, where no adequate muscular force can have been acting on the bone, and where the curve is obviously due to the weight supported by the hand in crawling, in the first instance, and by the legs in walking in the second. The softened bones are also peculiarly liable to fracture from slight causes. These fractures are very frequently unaccompanied by laceration of the periosteum, on account of the slight force that has produced them, and the thickened condition of the latter membrane, and are often of the incomplete or "greenstick" variety. The fragments in many cases are kept in apposition by the thickened periosteum; hence, when the disease is not in a very acute stage, rickety fractures generally unite kindly. Slight causes, however, soon reproduce them; so that rickety children sometimes present almost as miserable (though by no means so hopeless) a condition as adults affected by mollities. The softened condition of the bones also induces deformities of the walls of the great cavities of the body, which have a very material influence on the viscera contained in them. Mr. Shaw's essay will point out the great influence which an insufficient expansion of the chest in infancy has upon the shape of its walls, by exposing the bones to atmospheric pressure. Much more powerfully will this force act when the bones are softened even beyond what is natural in infancy. Hence one of the causes of deformity of the chest in rickets may be conceded to be the pressure of the atmosphere upon the softened bones, induced by incomplete expansion of the chest, the result of laryngismus stridulus, or of collapse of the lung-tissue—common affections in weakly children. A second cause is the outward pressure on the lower ribs, caused by enlargement of the liver and spleen, often present in these

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"rickets" be derived from the old French word *riquet*, which is the same as *bossu*? Some have supposed both "rickets" and "riquet" to come from the German *Rücken*.

[1] See also M. Broca's researches, quoted, in the translation of my work on Children's Diseases, by Dr. Larcher, p. 567.

[2] See Dr. Merei, Disorders of Infantile Development, p. 157.

cases;[1] and a third (which seems rather theoretically probable than absolutely proved) is the inward traction upon the cartilaginous extremities of the ribs by the attachments of the diaphragm. The result is a constriction of the chest, much as though a string had been tied tight round it below the heart, whilst its apex is distended. Except in very severe cases, this deformity of the chest may be expected to be effaced as the child recovers from the constitutional taint.

The pelvis is often the seat of deformity, whereby its outlet is much narrowed, the tuberosities of the ischia being pressed towards each other, and the pubic arch widened; or else the face of the pelvis is pressed backwards towards its posterior wall, the tuberosities of the ischia are thrust outwards, and the pubic arch widened.[2] In some cases, again, the whole pelvis is said to retain the small size and imperfect development of infancy. Any of these deformities will, of course, oppose a serious, and perhaps insuperable, obstacle to parturition in after life; and the change of shape of the outlet is often a source of embarrassment in lithotomy in children. This embarrassment, however, seldom proves serious; but a case is on record in which the operator was obliged to abandon the attempt to reach the bladder on this account, although a renewed attempt was more successful.[3]

The existence of a constitutional cachexia is proved in some cases by an interval of languor and general ill-health preceding the appearance of any disease in the bones; but very generally the latter symptoms are the first which attract attention. The disease commonly begins before the age of two years, although often earlier, and even in intra-uterine life, forming one of the causes of congenital fracture. The child, if it has been able to walk, loses that power: if it has not, it does not make the usual efforts to "find its feet." It loses the activity both of mind and body which is natural to early life, and its muscular strength diminishes. Enlargement of the ends of the long bones where the shaft joins the epiphysis, and of the ribs where they join their cartilages, is early noticed; and soon the fact of the bones being softened is proved by their yielding to mechanical force, and becoming distorted. The enlargement of the joint-ends is most perceptible at the wrist and ankle, especially the former, on account of the superficial position of the bones; and therefore the swollen state of the ends of the radius and ulna, together with that of the ribs, is the familiar test of the existence of the disease; but dissection proves that the same condition exists in the deeper-seated bones. It must not be forgotten that a slight enlargement at this part of the bones is natural in very early life.

There are some other symptoms which, although they are not essentials of the disease, nor can be relied on to diagnose it in the absence of the affection of the bones, yet are very constantly met with in rickets. These are retarded dentition, retarded closure of the fontanelle, enlargement of the head, sweating of the scalp, and a tendency to throw off the bedclothes at night. Muscular weakness is also generally a prominent symptom, even beyond what the softened condition of the skeleton would account for. The assemblage of such symptoms would lead to the suspicion of impending or commencing rickets, and in consequence to prophylactic treatment founded on such suspicion; but the enlargement of the ends of the bones with softening of their shafts is the only diagnostic mark of the actual presence of the disease. Reference must again be made to the following section, by Mr. Shaw (p. 895), for a description of the arrest of growth and development connected with rickets.

Rickets, in milder and ordinary cases certainly, and in all cases probably, tends to a natural cure. The deformed bones become consolidated, and remain, during life, in the shape which they have thus been caused to assume. They are then thicker and heavier than the natural bones.[1] The stature is thus diminished; but the constitutional vigor and the muscular strength is soon recovered when the cachexia has passed away, and the child, though small, is strong and sturdy. There are cases, however, in which the viscera of the chest have suffered from the pressure of the softened bones, or in which the child's life is endangered by collapse of the lung, or laryngismus stridulus, affections which the softening of the parietes of the chest makes doubly dangerous. From these causes many rickety children die.

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[1] On the enlargement of the viscera in rickets, see an interesting paper by Dr. Dickinson, Med.-Chir. Trans., vol. lii. The author shows that the enlargement is due to a different deposit from that of lardaceous or amyloid degeneration—that it bears some analogy to the affection of the bones, and that it rapidly disappears as the disease yields to treatment.

[2] Humphry on the Skeleton, p. 447.

[3] Sir H. Thompson, in Med.-Chir. Proc., Nov. 24, 1863.

[1] In this stage of rickets premature consolidation of the diaphyses and epiphyses sometimes occurs, leading to still further want of height, and to the dwarfed condition occasionally noticed.

The diagnosis of rickets is generally easy. The swellings of the joint-ends of the bones and of the bony ends of the ribs, the constriction around the chest, the bent limbs, the large abdomen, the large head and small face, the habit that the child displays of tossing off the bed-clothes at night, the perspiration of the scalp, and the frequent occurrence of bending or fracture of the bones, are symptoms of unmistakable import. In early cases, the disease may generally be detected by the condition of the epiphyses and the shape of the chest.

The medical treatment of rickets is much the same as that of scrofula. The child is to be placed, if possible, in a pure air, and fed upon nourishing and simple food; the skin is to be excited to healthy action by periodical bathing and sponging; the state of the secretions is to be carefully attended to. Cod-liver oil appears in most cases to be beneficial, and a little iodide of potassium may be combined with it; or the syrup of the iodide of iron, or some of the preparations of iron. Phosphate and superphosphate of lime used to be combined with iron at the Hospital for Sick Children, under the idea of supplying material directly for the consolidation of the bones; but after a patient trial, it was thought that the cases did not do better than under the use of iron alone.

The surgical treatment of rickets is a matter of more doubt. Some physicians teach that the deformity of the limbs cannot be reduced by splints; that the weight of the splints on the lower extremities is liable to be injurious to the pelvis, and increase its tendency to deformity, while it is a great obstacle to the use of the weakened muscles, and so hinders healthy exercise; and for these reasons discard the use of splints altogether, and advise that the child should be kept at rest and hindered from walking, when the healthy action and balanced tone of the muscles will, it is hoped, do what is possible to redress the curvatures of the softened bones. But, with submission to men of high authority, I cannot help thinking that this is an error. I believe that I have seen crooked limbs very materially straightened by the judicious use of light firm splints, always supposing that the case is presented to the surgeon before the stage of consolidation has arrived; for afterwards the use of splints can only do harm. At any rate, they exercise a most beneficial influence in opposing further deformity; and in cases where it is important to prevent the child from standing or walking, they may be so applied as to project below
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LATERAL CURVATURE O

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proposed as a synonym. "
curvature" might perhaps
as indicating that the spine
curved sideways, but was
rotation of the vertebræ
axis, at each bend.

The degree of deformity
shoulders, hips, or trunk in g
by the combined incurvatio
of the spine, is, in many ca
great. But the changes in
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Patients in whom the distor
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ets.[1]

Lateral Curvature is incid

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[1] See article on DISEASES
Also below, p. 893.

Commencing insidiously, without warning from bad health, it can only be stated generally that the first appearances of it may be looked for at about ten or fourteen years of age. The progress which it makes at first, in correspondence with the youthfulness of the patient, is commonly rapid; in proportion as the bones become more consolidated with increasing years, it is slower; and at about seventeen, when the skeleton has nearly reached maturity, it may be said to have arrived at its last stage; it is then comparatively stationary; neither disposed to advance, nor capable of being amended by treatment.

A distinguishing characteristic of Lateral Curvature is, that it is incomparably more frequent in girls than boys.

Moreover, it is met with among the daughters of the rich in tenfold greater numbers than among those of the poor.

Predisposing causes.—The chief peculiarity in the construction of the vertebral column, which makes it liable to become incurvated, is that, although its chief office is to support the superincumbent weight, it is at the same time flexible. Again, this many-jointed pillar, instead of resting on a fixed foundation, is reared upon one which is constantly changing its level. The pelvis, upon which the spine is erected, is poised on the globular heads of the thigh-bones, and it rolls and pitches at various angles according to the positions of the limbs. The column is, therefore, subject to be deflected from the perpendicular at each shifting of the base, when the weight it sustains will be thrown unequally on its articular surfaces.

The spine, at the age when Lateral Curvature commences, has attained nearly its full length. That forwardness is in conformity with the development of the cord within, for the slight addition to the column which takes place later is made at the base alone; that is, below the level of the cord itself, and in the region of the "cauda equina." The subsequent increase in the general height is chiefly owing to the elongation of the lower extremities, the growth of which goes on till adolescence.[1] But although thus advanced in length, the ossification of the spine has not made equal progress. The cartilage is in disproportionately large quantity compared with bone. The epiphyses on the upper and under surfaces of the bodies consist chiefly of cartilage. The texture of the bodies themselves is porous and spongy, and their surfaces in relation with the epiphyses, instead of being flat, are partly convex and rounded as in infancy; the pedicles, laminæ, and processes of the posterior segments of the vertebræ, besides being deficient in density, are imperfectly moulded in shape; and the borders of the articular facets of the oblique processes, instead of consisting of bone, are edged with cartilage.[1]

The muscles which elevate the spine are distinguished both for their great number and the variety of the directions in which they severally act. That arrangement appears related to the fact that the extensive movements of the column consist of many combined lesser motions performed in a series of adjoining vertebræ. It may likewise be a means of providing for the prompt adjustment of the superincumbent weight to the centre of gravity, in the numerous deviations of the spine from the straight line in the ordinary motions of the frame. It may be added that these muscles are inserted into the vertebræ close to their centres of motion; they will therefore act upon them at a mechanical disadvantage; but the power thus lost is amply compensated for by the assistance which they derive from the elasticity of the column.

For keeping the muscles of the spine in a state of average strength, it is necessary that a proper amount of active, varied exercise should be allowed. But in the case of young females of the class of society in which lateral curvature is most common, certain circumstances tend to prevent them from obtaining it. The age at which the deformity commences coincides with that at which a notable change takes place both in the physical and moral constitution of a female. As the period of puberty approaches, a girl begins to show tokens of her feminine character. Having been previously, like her brothers, full of animal spirits and fond of romping games, she spontaneously takes to sedentary occupations. And the style of her education harmonizes with her disposition. The time given to learning and accomplishments is disproportionately great compared to that allotted to the bodily graces and preserving the health. Being obliged to sit at the piano and other lessons for long periods together, the young pupil naturally gets tired. But she instinctively finds that by stooping or bending to either side, she can relieve herself from the fatigue. And the explanation is this: by throwing herself into these awkward attitudes, she removes, if not wholly, in great part, the task of supporting the spine from the muscles of the back, and imposes it on a different class of structures: when she stoops or bends excessively, not only are all the ligaments of the spine, elastic and others, brought into a state of tension, but the various tendinous expansions, layers of fasciæ and intermuscular septa, connected with the muscles of the back, are extended and act as ligaments in upholding the body. Now the fibrous structures enumerated are devoid of sensation, and incapable of feeling fatigue. But the result of indulging in these lounging habits is, that the ligaments and allied parts become overstretched and unqualified to knit the bones together. It is as if the shrouds of the mast of a ship had been slackened and required bracing; and owing to the loosened and relaxed condition, the muscles are overtasked to keep the column erect.[1]

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[1] Infra, p. 895.

[1] Two preparations of the spine, preserved in spirits, showing the extent of ossification of its different parts at the age when lateral curvature commences, are contained in the Museum of the Middlesex Hospital.

Another source of weakness of the spine, indirectly involving the osseous and ligamentous structures, may be traced to muscular debility. When the muscles lose power, the loss is felt beyond their own sphere. It is a law of the animal economy, that an intimate relation should exist between the muscles which originate force, and the bones and joints which bear the brunt of it. The mutual connection may be illustrated by the case of the trained boxer. In proportion as the power of his muscles increases, the density of the bones and tenacity of the ligaments are augmented. Were it otherwise, and the muscles of the arms acquired great strength, while the humerus and the ligaments of the elbow, for example, were relatively weak, he would be in danger of fracturing the one or dislocating the other, when he inflicted a heavy blow with his fist on his adversary's head. And the converse is equally true; in proportion as the muscles diminish in power, the bones become less solid, and the ligaments less capable of resistance. Applying the law to the state of the bones and joints of the spine, it will be seen that when the muscles have been debilitated by inaction, a corresponding degeneration of the internal structure of the vertebræ and of the ligaments will ensue.

On viewing the mechanism by which the apparently inconsistent qualities of stability and mobility are combined in the spine, it will be observed that the vertebræ rest and move upon each other only at three distinct surfaces of contact, above and below respectively. These are, anteriorly, the fibro-cartilaginous articulations of the bodies; and, latero-posteriorly, the articulations of the wedge-shaped oblique processes. When the spine is straight, the pressure of the superincumbent weight will be divided equally among those surfaces; and no damage need be apprehended. But it will be otherwise when the column is inclined to either side, and is allowed to remain curved. The effect which will be produced on the concave side of the curve will differ from that produced on the convex; but both will tend, each in its own way, to render the bend a permanent one. When the spine leans to one side, it is obvious that the weight of the body will fall exclusively on the articulations situated on the side to which it leans, and that a convergence of the adjoining structures will take place: hence the force acting on this, the concave side, will be one of compression. Again, it is obvious that the effect of the inclination on the articulations of the convex side, will be that of separating the surfaces, and producing a divergence of the connecting structures: accordingly, the force here will be one of dilatation. Now it is important for our subject to observe the changes which will be produced in the articulations by the operation of these distinct forces. By the former acting on the concave side, namely, compression, there will be, as the first change, overstretching of the ligaments, which will allow the surfaces to glide past each other beyond normal bounds, in a downward or converging direction; and subsequently the bony structures will come into collision and undergo absorption. By the force of dilatation acting on the convex side, the ligaments will be overstretched in an eccentric or expanding direction: the surfaces will thus be allowed to keep apart: absorption will not take effect; and the bony structures will preserve their natural forms and dimensions. The general result will be that the vertebræ included in the curve will receive a bias to incline sideways, first, from the weakness of their articulations, and next, from the unequal changes in their bony surfaces and processes. And such, it may be added, constitutes the beginning or starting point of lateral curvature.

General Appearances of Lateral Curvature.—The deformity varies considerably as to the degree of the incurvations, and their relative places in the spine, in different cases; but a typical form can be recognized in all, proving their identity in origin and kind. According to it two curvatures coexist; one above the other, and one balancing or opposing the other; so that together they describe a serpentine line, like the italic letter *f*. The superior curve is situated more or less high in the

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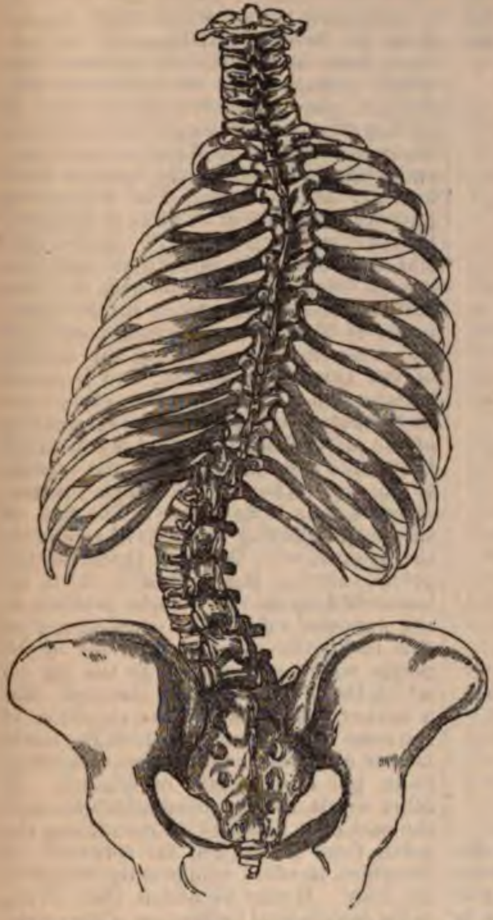
[1] Much stress is commonly laid in orthopædic works upon the bad effects of tightly-laced stays in inducing Lateral Curvature in those who wear them. But it is not customary for girls of the tender age at which the deformity commences to be dressed with stays of that kind. It is their older sisters alone who can be charged with the vanity.

Fig. 958.



This figure represents the curvatures and contortions of the spine, with the changes in the positions and forms of the ribs, in a case of lateral curvature, at a comparatively early stage of its progress—when, perhaps, just recently discovered by friends.

dorsal region; the inferior occupies the lumbar.

In general the curvatures just mentioned are the only ones. But if the dorsal be lower than usual, a curve in an opposite direction, formed of the upper dorsal and lower cervical vertebræ, will probably be found. Again, in the sacrum, a slight diminution of breadth on one side may represent the presence of a curve there, the counterpart of that above in the lumbar region.

The course which the different curves follow, in reference to the sides of the body towards which they respectively bend, is so uniformly the same in a large majority of cases, that it appears governed by a general law. Thus, looking first to the lumbar curve, experience shows that, in about nine patients out of ten, the column is deflected from its base to the left side, and that it is then inclined to the right; thereby forming an arc, the concavity of which is on the right. As to the dorsal curve, the direction it takes is determined by that of its fellow; for as the one is placed counter to the other, the arc it describes will be concave on the left. In those exceptional cases in which the above rule is departed from, the course of the curves is reversed; the concavity of the lower looks to the left, and that of the higher to the right.

But the curvatures do not consist simply of lateral archings of the spine. Combined with each curve to either side, there is a vertical twist in the column, consequent on a partial rotation of the vertebræ on their long axis. And the direction of the contortion in reference to the curve is constantly the same; that is, the revolution of the vertebræ is always such, that their sides corresponding to the concavity are wheeled forward, and those on the convex side backward. It follows that, as the spine is bent laterally, and also contorted longitudinally in the upper curve, and is also similarly bent and rotated in the lower, but in a contrary direction, a spiral or corkscrew condition will be produced; or the column will present an appearance not unlike what might be supposed to result from taking it, when soft, at both ends, and twisting it between the two hands as a washerwoman wrings a wet cloth.

And here it may be convenient to notice a source of deception connected with the contortion, to be guarded against in examining a young person's spine for the detection of lateral curvature. The ordinary way of proceeding is for the surgeon to run his finger down the ridge of spinous processes, and by dotting the tip of each in in its turn with ink, obtain a line representing the curves. To prove the fallacy of the method the adjoining diagram is introduced. The bold, outer, curved line is intended to show the course of the bodies of the vertebræ; the faint dotted one that of the apices of the spinous processes. It will be seen that the combined effect of the twofold incurvations and contortions in the dorsal and lumbar regions is to make the tips of the spinous processes, above and below, range themselves into a line which is nearly straight. That result is owing, first, to the fact which has been stated—that in the contortion accompanying each curve, the spinous processes point toward the concave side; and, secondly, to the concave aspects of both curves, upper and lower, being turned in common to the median line of the body. It follows, of course, from the apices of the processes in each equally approaching the median line, that the joint curvature which they describe will deviate but slightly from a straight line. Hence it is obvious that a false idea will be given, by trusting to that mode of examination, of the extent of the curves as existing in the bodies of the vertebræ, on which parts the stability of the column mainly depends.

Fig. 959.

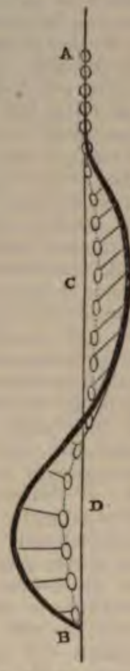


Diagram of spinal curvature.

Formation of the curvatures.—The inquiry may now be made how the two principal curves originate, with the order of their succession, if they follow each other.

Anatomical reasons point to the probability that the lumbar curve is first formed. 1. The vertebræ of that region, being situated at the bottom of the column, have the whole superincumbent weight accumulated on them. 2. This part of the spine is highly flexible: decidedly more so than the dorsal. 3. Owing to the unstable character of the base—the pelvis—on which the lumbar vertebræ rest, they are more prone than others to be deflected from the perpendicular.

The question may therefore be asked, if there be any particular position into which the lumbar vertebræ are liable to be habitually placed, which might expose them to become permanently curved. Now, there is a particular posture into which persons have an instinctive tendency to place themselves for the sake of getting relief when fatigued in their lower limbs, either from walking or standing; and while indulged in, the spine is bent laterally at the loins. The attitude is known in the drill of soldiers as the position of "standing at ease." And a special mechanism is introduced into the human frame in connection with it. The part of chief consequence in the apparatus is that strong membranous web which covers the muscles on the outside of the thigh as a sheath, and is called "fascia lata." This dense structure is attached extensively above to the external lip of the crest of the ilium, and is continued below into a similar fascia on the outside of the leg. The way in which the mechanism acts is as follows: The foot of the person having been fixed solidly on the ground, with the knee extended, the pelvis, carrying the body with it, is allowed to drop into an oblique position to the opposite side. The consequence of this inclination is, that the side of the pelvis which corresponds to the leg on which the person stands is elevated. But a further result ensues; the elevation of the crest of the ilium, to which the fascia lata is attached, causes that membrane to be put into a state of tension. In other words, the expanded membrane acts the part of a ligament in restraining the pelvis from falling too far sideways; it therefore, in effect, supports the weight of the body. It may be added, that, owing to the same lateral inclination of the pelvis, the head and neck of the femur are drawn outwardly from the acetabulum to the extent of putting the capsular and round ligaments on the stretch; they will therefore assist in locking the hip joint, and fixing the pelvis. In that manner, the task of keeping the body upright is thrown off the muscles and given up to fibrous or ligamentous parts; and it follows that, as these structures are devoid of sensation, they can perform the duty without fatigue.[1]

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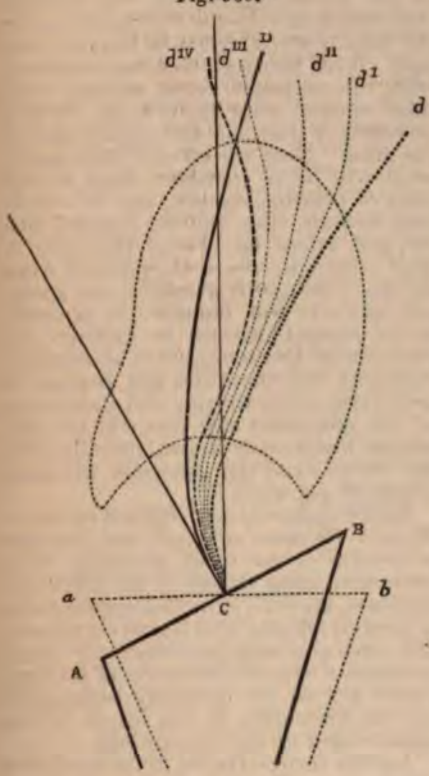
[1] Among the lower animals mechanical appliances for economizing muscular exertion, analogous to that in man, but differing in construction, are met with. The bird which roosts, has one kind of apparatus; that which sleeps standing on one leg, has another. Although the horse has four legs, he is not without a provision in his hind quarters, and the mechanism is like that in man, for relieving his overworked muscles.—System of Anatomy and Physiology, by John and Charles Bell, vol. i., p. 385, 7th ed.

But what is of greatest interest in connection with the attitude, is the curvature in the spine required for preserving the equilibrium. The appearance of that deviation will be best seen by observing a young person whose joints are flexible, lounging lazily on one leg. A large sweeping curve, equal to about a semicircle, will be found extending from the lower part of the dorsal region to the sacrum. Now, if it be admitted that the posture is one of ease, which gives relief to the muscles of the limbs when fatigued, and is, moreover, frequently indulged in, it may be granted that the curve will be prone, in a young, growing person, especially of delicate frame, to become permanent. The vertebræ, and all the structures connecting them, will be in danger of undergoing changes in their forms and relations, to accommodate themselves to the position. Supposing, therefore, that the curvature has become confirmed, and that it is situated principally in the loins, what effects may be anticipated?

Fig. 960.



A, B, oblique line of pelvis when standing on right leg. C, D, curvature of spine consequent on oblique direction of the pelvis. a, b, horizontal line of pelvis, as in the posture of sitting; C, d, position into which the spine, having become curved in the loins, is liable to fall when the pelvis is placed horizontally. The curve in the loins being permanently established, the exertions of the patient to restore the equilibrium tell only on the part of the spine above. The dotted lines, C, d^{i}, d^{ii}, d^{iii}, d^{iv}, indicate different stages in the formation of the dorsal curve.

It is obvious that so long as the person in whom the curvature exists can keep the pelvis poised in its oblique position, he will experience no inconvenience, because the deviation is adapted to it. But the circumstances will be greatly changed when he adopts a posture in which the pelvis is necessarily horizontal. That is the case in sitting or in walking. It may therefore be expected that when a person in whom the spine has acquired a permanent bend near the base sits or walks, not only the column, but the whole superstructure reared upon it, will fall extensively to one side.

It might, perhaps, be thought that this lumbar curve could be rectified by the patient exerting the muscles of the back to prop up the spine, or by poising the pelvis in a contrary line to the first. But these attempts will be unavailing for two reasons: First, they will not succeed on account of the changes in the relative dimensions of the two sides of the vertebræ, and of the connecting structures, contingent on their curved shape; secondly, owing to the contortion of the vertebræ which invariably accompanies lateral incurvation, the several processes and articular surfaces are so much altered in their relative positions that they become mutually interlocked, and the movements between them are checked or arrested. Accordingly, as the lower curve cannot be overcome, and the equilibrium must be restored, the only alternative is the formation of a new one above it, and in counteraction of it. The spinal muscles on the convex side act on the upper part of the spine; and by gradually raising it and drawing it toward the median line, they eventually bring its summit over the seat of the centre of gravity. The muscles attached to the head and to the shoulders contribute to adjust them also, and direct them to their correct places. Thus the superior or dorsal curve is formed.

A part of the problem remains to be solved. It has been pointed out at p. 885, as a remarkable feature of the deformity, that, in a large majority of cases, so great that the exceptions to the rule are few, the direction of the curves is such, that the one situated in the loins is concave on the right, and the one in the dorsal region consequently concave on the left, of the body. If the explanation of the mode of formation of the lumbar curve given above—namely, that it is from an acquired habit of standing on one leg—be correct, it may then be inferred, as accounting for the concavity being on the right side, that the right lower extremity is more frequently selected for standing upon than the left, because by resting on it the curve takes that direction. Now, it coincides with our knowledge of the comparative strength of the members of the two halves of the body, as well as of their obedience to the will, to suppose that the right should habitually be preferred. Man, it may be alleged, is right-footed, as he is right-handed. And we are not without an argument in favor of the supposition derived from military drill; the posture of the soldier, when ordered to "stand at ease," is alike in the disciplined armies of all countries; he places the right limb firmly under him, straightened and fit to support the weight of his body; while so doing he elevates the right and depresses the left side of his pelvis; the left leg is consequently relaxed and bent; and as the shifting of the pelvis has the effect of making the base of the spine oblique, he is obliged to lean his body to the right in order to recover his balance; thus a curve of the spine, which is concave on the right side, is formed.[1]

Causes of the contortion.—It may now be inquired into, how the twisting of the spine on its long axis, which is an invariable accompaniment of the lateral incurvation, is produced. The contortion is about equal in degree both in the lumbar and dorsal curves. The rotation has also a definite relation to the curves; being always directed in such a manner that the concave sides of the vertebræ are wheeled forward, and the convex, of course, backward.

It has been stated above (p. 884), when adverting to the surfaces and processes by which the vertebræ are articulated, that the only solid structures, as distinguished from the muscles and ligaments, which intervene to check or arrest lateral movement in them, are the oblique processes. It was also shown that, when the muscular and fibrous structures were inefficient, and the spine inclined to one side, the effects produced on these processes by the pressure of the superincumbent weight differed essentially on the two sides of the column; that from the weight being received wholly on the concave side, the oblique processes of that side were shortened and flattened by absorption; while, owing to the processes on the convex side escaping compression, they preserved their normal shape and size, and diverged from each other. The influence which this contrast in the rate of consumption of the substance of the vertebræ on the two sides may have in causing contortion to be combined with lateral incurvation, will be apparent when we take into view the relative position of the processes to the central axis of the spine. They are placed postero-laterally in the vertebræ. Consequently, at the same time that the column falls sideways, a rotatory movement, in a partially horizontal plane, will take place upon the oblique processes of the concave side as centres or pivots, and the vertebræ will, therefore, perform an imperfect gyration, with their sides, which have undergone the chief destruction, pointing forward.

From this description it may be perceived that the addition of the contortion to the lateral incurvation will conduce very considerably to the deformity becoming rapidly worse, when it has once begun. It has been seen that, in conformity with the vertebræ being rotated with their concave sides forward, the oblique processes of that side are carried toward the front. Now, the effect of that movement will be to transport them to the place of principal danger; for, by travelling forward, they will be brought into the part where the curve of the spine is most acute, and where the pressure from the superincumbent weight is also greatest; and they will, therefore, be exposed, in an especial manner, to undergo destruction of their substance by absorption. Again, as the curvatures will increase in proportion to the wasting and shortening of the processes, new sets will be constantly involved or drawn literally into the vortex; and the deformity will progressively get worse.[1]

Special appearances of different curves.—*Trunk.*—Decrease of height, and increase of breadth in the trunk generally, with disproportionate length in the lower extremities, are early exhibited appearances in persons affected with lateral curvature. The arms also seem preternaturally long, in contrast with the shortness of stature. These defects are obviously consequent on the diminution in the height of the spine caused by the incurvations.

Lumbar curve.—Owing to the thickness of the mass of muscles in the loins, and the natural arching of the vertebræ forward causing a hollow behind, the lumbar part of the column does not come so distinctly into view as the dorsal; hence it is not always easy to discover a curvature in it, especially at its incipient stage.

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[1] For additional illustrations, see Treatise on the Hand, by Sir C. Bell, p. 92, 6th edition.

[1] On the nature and Treatment of Distortions of the Spine and Chest. Engravings illustrative of the above work, in folio, 1824, by John Shaw. "Paper on Rickets," by the writer, Med.-Chir. Trans., vol. xvi., p. 468, 1832.

The only apparent sign of there being one may consist in the waist being peculiarly short and broad, which indicates that the lumbar vertebræ have yielded to the pressure of the superincumbent weight and become curved. To estimate the weakness of the part, the patient may be instructed first to place herself in a lounging posture; the clumsiness of the waist will then be perceptibly aggravated; but by asking her again to make a strong effort to elevate her body, a visible improvement will take place: not only will the length of the waist be increased, but its natural slimness will be restored; and that condition will last so long as she continues the exertion.

Supposing the deformity more advanced, the first thing perceived in the loins will be a want of symmetry between the two sides—a narrowness and fulness on the one, and an expanded sunken condition on the other; the contrast being more apparent if the patient stand in a slouching position. In correspondence with what has been stated above (p. 885), that, in a large majority of cases, the curvature in the lumbar region is convex on the left side, it may be expected that the fulness referred to will be situated on that side. This consists in a prominent ridge, which follows the contour of the lumbar curve, on its outer or convex aspect. It is caused by the combined incurvation and contortion of the vertebræ of the loins. The former has the effect of making the lateral surfaces, especially the transverse processes, on the convex side, diverge; the latter causes the same parts to project posteriorly. Accordingly the muscles which lie upon the vertebræ on that side will be stretched, and also thrust back, so as to form a curved, rounded swelling. If the contortion be considerable, the consequent displacement of the muscles may be so great that their inner margins, in relation with the vertebral ridge, will overlap the points of the spinous processes, and conceal them. As in cases of slight curvature, the fulness may not be easily recognized, the best mode of bringing it into view is to direct the patient to bend forward, as in making a bow, when the inequality will be distinctly visible.

In proportion as a lateral curve at any part of the spine becomes more acute, the accompanying contortion is increased; and the bulging at the convex side, chiefly caused by the latter, is augmented to a corresponding degree; so that the affected part presents the appearance, in extreme cases, of a defined angular projection rather than of a curve. That condition is more commonly witnessed in the dorsal than in the lumbar region; yet cases have been met with in the loins, wherein the rotation of the vertebræ on their long axis has equalled not less than quarter of a circle in the circuit; and in which the vertebræ at the principal bend, when looked at from the back, were seen in profile instead of posteriorly. In a case of that kind, in the person of a surgeon, the protuberance on the side, of a globular shape, was so large, and the boundaries apparently so well defined, that the displaced vertebræ were actually mistaken for some morbid outgrowth.

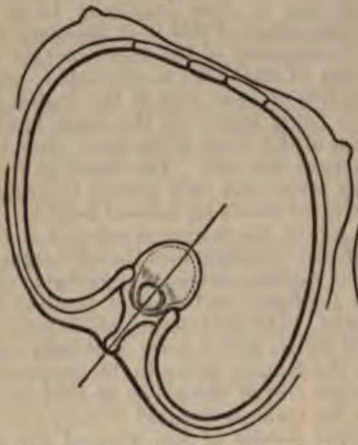
Another effect produced upon the figure, by the lumbar curve in connection with the pelvis, may be noticed. As the vertebræ spring from the sacrum, they incline, in the first part of their course, at such an acute angle to the left that they follow the line of the brim of the pelvis, and are in close proximity to it. The consequence of this near approach is that the boundary of the upper margin of the wing of the ilium is concealed; and the surface of that part of the region of the hip being nearly on the same level with that of the ridge of the spine, they appear merged into one. The result is, that the hip seems not only greatly enlarged, but elevated above its normal height.

Again, the intrusion referred to of the inferior vertebræ into the left lumbar and iliac regions, causes a remarkable change in the figure and relative position of the waist. The contraction which constitutes the waist, and is more strikingly marked in the female, owing to the comparatively larger size of the pelvis in that sex than in the male, is situated directly above the upper border of the wing of the ilium. But in consequence of the encroachment of the lumbar vertebræ into that part, the hollow is filled up, and a fulness or bulging takes its place. Hence a substitute for the waist must be sought for at a higher level. Now, the only hollow on the left resembling that which ought to be found at the crest of the ilium, is a constriction situated altogether above the lumbar region; namely, the narrowing of the chest, just below the scapula, caused by the convergence of the ribs in correspondence with the concavity of the dorsal curve. The representative of a waist, therefore, on the left side, has its place in about the centre of the thorax, instead of between it and the pelvis.

The appearance of the lumbar region on the concave or right side of the curve, presents a general contrast to that on the convex. Owing to the spine receding from its base to the left, in forming the curve, the right side has greater breadth across than the opposite; and owing to the column being rotated on its long axis with the right sides of the vertebræ forward, a flatness, or hollow, or even a flexure in the surface, is produced. But a notable difference between this side and the convex will be perceived, especially in the form and situation of the waist. Owing to the inclination of the spine to the left, the right side of the pelvis becomes particularly distinct, and juts out like a promontory. Consequently this lower boundary of the waist comes conspicuously into view, and the flexure above is abnormally deep. The contraction, however, on the left, which alone corresponds to a waist, is merely a hollow in the side, from depression in the ribs, and is situated far above the level of the proper place of the waist: so that a line drawn between them would be highly oblique, instead of horizontal.

Chest.—From the upper or dorsal curve being situated in the part of the spine to which the ribs are attached, the walls of the chest are included in the deformity. Again, as the scapulæ rest on the chest, the position of the shoulders is also involved. Further, owing to there being a natural stoop forward at the dorsal region, the features of the distortion are rendered to a certain degree more distinct than below. And it may not be omitted to mention that the difference in the amplitude of the dress worn by ladies above and below the waist, has some share in making the upper attract greater notice than the lower curve.

Fig. 961.



Supposed transverse section of the thorax about its middle: to show the displacement of the ribs consequent on the contortion of the dorsal vertebræ.

Fig. 962.

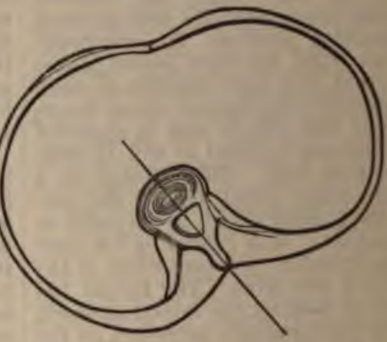


Diagram representing a supposed transverse section of the abdomen, at the lumbar region.

On examining the dorsal region of a patient in whom the deformity is incipient, the first thing to be remarked will be, as in the loins, a want of symmetry on the two sides. Supposing the case to be one of an average kind, there will be increased fulness and elevation on the right, and contraction with depression on the left. The line of the lateral curve will be traced by following the course of the spinous ridge. But in order to estimate the accompanying contortion, the elevations on each side of the ridge, corresponding to the transverse processes, must be looked to; when that upon the convexity will be found abnormally protuberant, and that upon the concavity proportionately depressed.

Attending next to the ribs: the changes in their position are twofold, depending on distinct causes. Taking the convex side first, the ribs radiate from the spine, like the rays of a fan, so that the distal ends are separated and the intercostal spaces enlarged; but in addition to this, they project backwards. Looking next to the concave side, the ribs converge, like the spokes of a wheel concentrating to the axle, and their distal ends approximate; but in addition, they advance forward. Hence it will be perceived how the right half of the chest, as looked on posteriorly, should be both abnormally expanded and protuberant, and the left both contracted and depressed. Again, it will be found, as might be anticipated, on turning the eye to the front, that the anterior ends of the ribs and costal cartilages are flattened or depressed on the convex or right side, and prominent on the left. These changes in the directions of the ribs depend, it is obvious, on the analogous ones in the spine: the ribs being like the indicators on a dial plate, magnifying the movements at the centre. The radiation on the convex side results from the divergence of the articulating surfaces appropriated to the ribs on that aspect of the spine, connected with the lateral incurvation; and the projection posteriorly results from the rotation of the vertebræ on their long axis, connected with the contortion. A similar explanation, but with the order of the changes reversed, applies to the concave side.[1]

Shoulders.—From the scapulæ being placed loosely on the summit of the chest, and retained in their places only by the muscles, and by their articulations with the clavicles, they are free to rise, sink, protrude or recede in conformity with the variations in the forms of the chest. As the upper ribs, of the convex side, which support the right scapula, are both elevated and directed posteriorly, the shoulder is not only raised above its ordinary level, but projected backwards: hence it is high and bulging, as if enlarged, and fits closely against the side. The ribs on the concave or left side are pointed downwards and forwards, so as to cause a general collapse of the upper region of the chest: the scapula is thus deprived of support, and is held in its place principally by its attachment to the acromial end of the clavicle: the shoulder, therefore, falls down by its own weight and that of the arm below its proper level; it also stands off apart from the body, with a flattened and pendulous appearance. It will presently be seen that, in certain extreme cases of the deformity, in which the ribs on the convex side are wound about the vertebræ as a consequence of the contortion, that side is diminished transversely and loses its rotundity: the right scapula will then descend from its elevated position to the level of its fellow on the left. Occasionally the chest, together with the shoulders, is turned, as upon a pivot, by the wheeling round of the spine, to such a degree that its left side will face to the front and its right to the rear. The clavicles will revolve equally; and the displacement of one of these at its sternal articulation from this cause has been known to be so great that it has pressed on the trachea, so as to threaten suffocation, and necessitate partial excision.

Now, on comparing the line which represents the level of the shoulders, with that representing the waist, it will be perceived that each inclines in an opposite direction to the other; that the former dips from the right side to the left, and the latter from the left to the right. Again, the high and protuberant right shoulder is counterpoised by the apparently-enlarged haunch on the left; and the sloping, pendulous left shoulder, standing off apart from the chest, has a counterpart on the right in the projecting ala ilii, jutting out above the hip.

Gibbosity.—When lateral curvature, from neglect, becomes worse, the increase is almost always more rapid and extensive in the dorsal than in the lumbar region. Yet, when the different structures of the two parts are observed, it might not be supposed that such would be the case. In conformity with its office of giving support to the ribs in respiration, the dorsal portion has comparatively little freedom of motion; and its mobility is further limited by the ribs being applied along it on each side, like splints. But the rigidity of its structure does not render the part less liable to suffer from the causes which give rise to the deformity. When the process of absorption is excited by pressure, the destruction of substance which it produces is greater on its being met by a dead, inert force, than by one which is elastic and yielding; and it appears to be owing principally to the want of resilience in the structures composing the dorsal region, in contrast with the lumbar, that the curvature advances more rapidly and to a worse condition in it, than in the latter.[1]

The divergence and protuberance of the ribs on the right side, causing the corresponding scapula to be elevated and to project backwards, are the first stages in the formation of the abrupt prominence which becomes a "hump:" and as the spine bends, and becomes contorted to a greater degree, the gibbosity is naturally augmented. But soon an increase in the acuteness of the "angles" of the ribs, with a flattening of their centres or bodies, appears. That change is obviously caused by the progress of the rotation of the vertebræ on their long axis. As the spine revolves, the ribs are drawn to it, just as a rope in machinery is coiled about a barrel in circular motion. Accordingly, in proportion as the vertebræ rotate, the proximal ends of the ribs travel backward, and, by so doing, increase the acuteness of the angles. Again, as a resistance is made to the posterior movement by the attachment of the distal ends of the ribs to the sternum, a stretching force is applied, which has the effect of straightening their arches and flattening their contour. As the contortion advances, the line of angles is carried further backward, till it forms a prominent ridge, concentric with the spinous, and more prominent. The muscles which lie in the vertebral groove are so much displaced by the twisting of the column, that their inner margins overlap the tips of the spinous processes, and conceal them. When the deformity has proceeded thus far, the next stage in its progress is, that the proximal ends of the ribs, from their articulating heads to the angles inclusive, are transported bodily round, in their bent condition, by the circumvolution of the column, so as to be in actual contact with the sides of the vertebræ, and to be coiled upon them. The twisting of the spine on its long axis is, of course, very great in these extreme cases—being equal, it may be estimated, in certain of the vertebræ, to nearly a quarter of a circle; and at the same time that the contortion proceeds, the spine becomes more acutely bent. From these combined causes, a prominent enlargement, standing out abruptly from the centre of the back, with expanded ribs overlying the spine for its summit, is formed, constituting the hump.

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[1] The appearances described above will be made more distinct by the patient's stooping, so as to protrude the spine and adjoining ribs; as well as by crossing the arms in front, a-kimbo, to draw the scapulæ forward.

[1] This is exemplified by the mode of enlargement of an aortic aneurism. When the tumor has arrived at the walls of the chest, it perforates them by absorption. But the parts which yield most rapidly are not the intervertebral cartilages, the costal cartilages, or the skin, which are elastic, but the vertebræ, ribs, and sternum, which are relatively rigid.

Simultaneously with these changes on the convex side, equally great ones are being wrought on the concave. In proportion as the spine revolves, the sides of the vertebræ and the ribs connected with them are carried forward; and as the column bends increasingly, the articular ends of the ribs are caught and enclosed in the deep parts of the angle formed by the upper portion of the spine with the lower. Consequently, the sides of the vertebræ, more particularly the oblique processes, and the posterior halves of the ribs, undergo heavy pressure from the superincumbent weight. Hence they become extensively wasted by absorption. Large portions of the postero-lateral parts of the vertebræ disappear; the intervertebral substances are greatly thinned, and the bodies present a skewed appearance. As to the ribs, they are not only huddled closely together, but are attenuated so as to be scarcely thicker than goose-quills.[1]

It is manifest that important encroachments must have been made on the space within the chest, intended for the heart and lungs, by the changes in its parietes just described. All that part, for example, contained between the portion of the walls which had become folded about the spine, and the spine itself, on the convex side, would be lost to the pleural cavity. Again, from the contraction of the chest on the concave side, the room for the lungs would be greatly diminished. It may likewise be conceived that much embarrassment in the actions of respiration would result from the remarkable disfigurement of the ribs, particularly at their articulations. Nevertheless it is known that the various organs possess an extraordinary power of accommodating themselves, without impairment of their functions, to changes in their forms. Although, in extreme cases of distortion, the compages of the thoracic and abdominal cavities present both singular irregularities, and all the viscera contained in them undergo a new moulding of their figures to adapt them to the changes, yet each organ performs its function soundly. Thus the spinal cord submits to be altered both as to dimensions and shape, in accommodation to the tortuous form and abrupt angular bendings of the vertebral canal, without loss of function. On the concave sides of the curves, the intervertebral foramina become contracted and partially closed: it might be supposed that the spinal nerves would be pinched and injured in their passage through them; but experience does not show that any bad consequences follow.[1]

Mobility at junction of curves.—From the displacement upon each other of the several vertebræ, together with the changes in their figures, and derangement of their articulations, consequent on the incurvations and contortions, it may be anticipated that there will be great impairment of the motion of the spine at each of the curvatures. And observation proves that such is the case. If a patient be placed in the prone position, and extension and counter-extension be employed to straighten the curved portions, some increase in the length of the column, with a narrowing of the waist and improvement in its appearance, will be produced; but there will be no visible change either in the dorsal or lumbar curve, to show that it has yielded to the stretching. Again, if the patient be requested to lean sideways, in a contrary direction to either of the curves, as if to give the spine an opposite bend, little or no change will be effected by the movement. Lastly, suppose the patient make a powerful effort to elevate her body to the utmost, she will probably succeed in increasing her height, and there will be a distinct diminution in the thickness of her waist, but the curvatures will not be straighter than before; and, it will further be noticed that, as soon as she ceases to make the exertion, the body will fall, and the waist return to its former condition. It will, therefore, be concluded that the incurvated portions possess but little mobility, while the intermediate part, where the lumbar curve ends and the dorsal begins—being the dorso-lumbar region—possesses a greater degree of flexibility than belongs to it normally. And the reason of the excess of motion in the latter part may be easily understood. The vertebræ in that intermediate situation, from not having undergone the same changes in their relative positions which have occurred in the curved parts, have retained their mobility. Accordingly, as the portions both above and below have become comparatively rigid, it will follow that, in every extensive and powerful movement of the trunk, an undue impetus will fall on the part which has the greatest flexibility. Consequently, the structures of the joints of the intervening region will be overstrained, and it will require increased freedom of motion. When the writer was engaged in preparing by dissection the specimen from which the drawing for fig. 958, p. 885, was chiefly composed, he was led to observe how great a contrast existed between the stiffness in the lumbar and dorsal curves, and the looseness and mobility in the dorso-lumbar region.

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[1] The ribs coiled round the spine on the right or gibbous side, are broader and more expanded, besides being generally larger, than natural. That increase may be attributed to their having been subjected, while being wound about the vertebræ, to a dilating force, in contrast with a compressing one.

[1] The following is a remarkable example of the influence of a slightly disturbing cause in changing the shape even of solid structures during growth. A woman twenty-one years of age had been burnt in the neck when five years old. A broad cicatrix had the effect of drawing the head toward the sternum. But the interesting circumstance in the case was, that the lower jaw had become deformed in a peculiar manner, under the influence of the contraction of the cicatrix. The posterior portion of the jaw, subject to the masseter, temporal, and other muscles, preserved its natural form and position; so that the upper and lower molar teeth met when the jaws were closed. But the anterior or mental portion had been drawn down, in a curve, to such a degree, that the incisor teeth contained in it were separated by the distance of an inch from those of the upper jaw. The front teeth in the lower jaw were also placed horizontally instead of vertically. It was observed that the adhesions of the cicatrix to the subjacent parts were loose. (Case related by the writer, Trans. Path. Soc., 1849–50, p. 241.)

In Torticollis, commencing in childhood, it may be remarked that at adult age, the side of the head which is twisted obliquely downwards, between the shoulder and sterno-clavicular joint, is less fully developed than the other turned upward.

Diagnosis.

Angular deformity.—The only deformity within the bounds of the spine and chest, with which lateral curvature is liable to be confounded, is angular projection of the vertebræ consequent on caries. If the disease which causes the formation of the angle be seated in the dorsal region, the ribs attached to the column on each side are a bar to the spine bending sideways; but when the disease is lower, especially in the dorso-lumbar region, there may be a slight deviation to either side, and the angular may then present some of the appearances characteristic of lateral curvature. The principal distinguishing feature between them, so far as the deformity is concerned, is that contortion of the spine is an invariable accompaniment of lateral curvature, and is never present in angular; and as the signs of that twisting movement in the former are always recognized with ease, there ought to be no difficulty in perceiving the distinction. See article on DISEASES OF THE SPINE, p. 305.

Rickets.—The etymology of this term would lead to the supposition that it was applicable to diseases or deformities of the spine (ῥάχις), of all the various kinds. But by common usage it is now exclusively employed to denote a particular disease of the osseous system, in which not only the spine, but the bones of the skeleton generally, are affected. However, the meaning of the name would appear to have had some influence in causing the opinion to be long entertained that the formation of the curves in lateral curvature was dependent on a morbid change in the bones, allied in its nature more or less intimately to that in rickets. But as females are peculiarly prone to be affected with lateral curvature, and as a deformed and contracted condition of the pelvis, especially dangerous in child-birth, is a common consequence of the softening of the bones characteristic of rickets, it is important to determine whether there be any foundation for the opinion. And numerous reasons are opposed to it.

1. Rickets is essentially a disease to which children of early age are subject; but the period of life at which lateral curvature begins, is from ten to fourteen. 2. Males and females are affected in equal numbers by rickets; females are most frequently the subjects of lateral curvature. 3. Rickets is most prevalent in the poor; lateral curvature in the rich. 4. Rickets is a positive disease; in lateral curvature the health is undisturbed. 5. In rickets, the bones of all the body are either incurvated, or they show some other indication of a generally prevailing disorder—the spine and ribs are included, but so are the bones of the lower extremities—and the latter are commonly more distorted than the spine; in lateral curvature, on the contrary, the spine is incurvated and

the ribs distorted; but the ribs are distorted only as a consequence of the spine being curved; whence the spine is really the only part primarily curved, all the rest of the skeleton being normal.

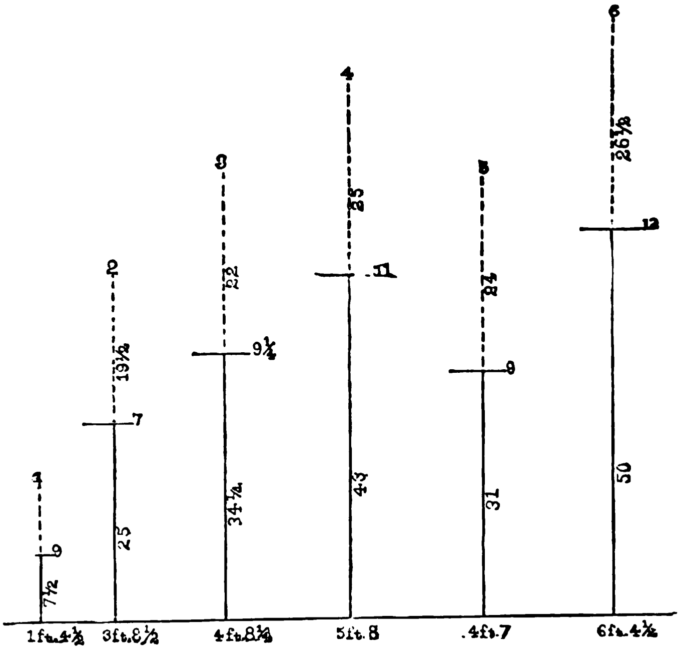
There remains another diagnostic sign. It relates to certain distinctions in the configuration of the adult frame. But to be understood, some preliminary explanation is required.

Rickets, it has just been stated, is a disease of early childhood, affecting both sexes equally. The usual period of its attack is between three and five years of age. It varies in its severity, as well as duration, in different cases; but its most general characters are—visceral derangement, with impaired nutrition, degeneration of the structure of the bones, chiefly marked by deficiency in the quantity of hardening material, and distortion of all the skeleton consequent on the morbid condition of the osseous system.

When the disease has run its course, within a period perhaps of one or two years, the patient will be restored to perfect health; but the deformity will remain; and he will bear the marks all his life, in the incurvation of the principal columnar bones, of his early illness. After, however, his growth has been completed and he has arrived at adolescence, an additional and different kind of change in his figure will be perceived. It will be observed that, independently of the curvatures, there is a deviation, in his configuration generally, from the standard relative proportions of the adult. It will be seen, in short, that he has failed to outgrow the child's form, and to change it for that of manhood.

To understand this subject, it is required, first, to keep in view the distinction which exists in the general conformation of the infant's frame, as contrasted with that of the grown-up person; and secondly, to consider what effects will be produced upon the figure, on the assumption that the growth is retarded or arrested during the active stage of rickets.

Fig. 963.



No. 1, relative proportions of upper and lower divisions of child near birth. The upper dotted line, in all, gives the length from vertex of head to crest of ilium; the lower bold line, from crest of ilium to ground; and the transverse line, the breadth of the pelvis. No. 2, at eight years of age. No. 3, seventeen years. No. 4, adult. No. 5, adult, stunted by rickets. No. 6, person of lofty stature. The measurements were taken according to a scale of one-twelfth of an inch to one inch.

In the sequel it will be seen that the inquiry embraces the form of the head, as well as the proportions of the whole body. When considering the latter, which may be taken first, it will be convenient to distinguish the upper division—consisting of the head, the trunk (down to the pelvis), and the upper extremities — from the lower—consisting of the pelvis and inferior extremities.

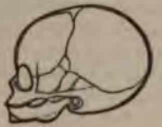
On comparing the form of the infant's frame with that of the adult, it will be perceived that the conformation of the former has relation to the act of parturition; while that of the latter has relation to man's erect position and his locomotion on the lower extremities. The adaptation of the figure of the fœtus to the process of delivery is exhibited at an early period of gestation. It is owing to the head of the young embryo being preponderatingly large compared with the nether extremity, and to the short and thick umbilical cord being attached to the smaller end, that the head falls into its place, from the beginning, over the orifice of the uterus, as it has to be expelled eventually the first. Again, while the bones generally, during fœtal life, enlarge at about an equal rate, the pelvis is kept in check, and is exceptionally small at the period of birth — a provision obviously designed to prevent the circulation in the umbilical cord from being stopped by pressure; which would occur if the pelvis were large, and blocked up the pelvic canal of the mother after the head had been delivered. But the newly-born baby, with its bulky upper, and diminutive lower quarters, is incapable of keeping its feet either to walk or stand; and it must creep on all fours. Accordingly, the proportions of the frame are reversed in the adult. The upper division—head, arms, chest, and abdomen—are small, light and easily carried; while the lower division—the pelvis and lower extremities — are massive, strong, and calculated for supporting and transporting the superstructure.

If it now be supposed that, while the childish frame is passing through this revolution in its proportions, in accommodation to new conditions, an attack of rickets should intervene, causing a temporary interruption of the growth, it is obvious that the stoppage will have the effect—as will be seen at adolescence—not only of stunting the individual in size, but of marring the proportions of his figure, by interfering with the fulfilment of the changes which ought to be wrought in the relative dimensions of the members of his body. He will present, when arrived at manhood, some of the appearances characteristic of childhood. Accordingly, the person of an adult rickety individual is observed to be diminutive throughout; his stature is short, even allowing for the loss of height from the incurvation of his bones; his head is large; the trunk also is large; but the hips are narrow, and the legs short.

And the converse of what has been stated is true. If the growth of the frame has been over-active, so that the natural changes have been carried to excess, as witnessed in uncommonly tall individuals, the proportions of the adult will be brought out to an exaggerated degree. The upper division—head, chest, abdomen, spine — will be relatively small, short, and light; while the lower—pelvis and lower limbs — will be inordinately broad, massive, and long.

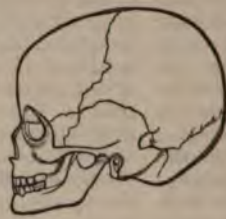
In the head, as intimated above, analogous changes in the relative dimensions of the cranial and facial divisions, occurring between birth and adolescence, may be observed, and they are subject to be modified by differences in the rate of growth in the same manner as in the whole frame. The peculiarity which principally characterizes the form of the child's head —apart from the fat chubbiness of the cheeks—is the small, contracted size of the face contrasted with the capaciousness of the cranium. Now, the subsequent increase of each of these two divisions is regulated by a distinct and appropriate influence. That which determines the growth of the cranium is the development of the brain; this important organ is distinguished for the early period of life at which it arrives at perfection; it has nearly attained its full size about seven years of age, and its increase subsequently is so slow and slight that its development may be said virtually to cease about fourteen. As the cranium therefore grows *pari passu* with its contents, it comes to maturity at the same speedy rate. The case, however, is different with the facial division. The influence which guides its growth is the development of the organs of mastication in particular. The toothless gums of the infant are adapted to the mode of its being fed by suckling. But in proportion as the two sets of teeth emerge in succession, the jaws, which had been remarkably small at first, commence to enlarge, and they go on progressively increasing till they become relatively of great magnitude. And it is not the maxillæ alone which grow in conformity with the teeth; the adjoining processes and surfaces from which the powerful muscles that move the lower jaw take their origin, consentaneously enlarge. Again, this active course of development in the facial division is continued for many years after that in the cranial has come to a standstill; it does not stop till adolescence; steadily and perseveringly, therefore the former has been making advances, in point of dimensions, upon the latter. It is accordingly found that the facial division, in the adult, has a much larger relative size than in the child. But if it be supposed that, while that change is being effected, a stoppage of the growth for a considerable period, as by rickets, should intervene, it is obvious that the part which ought to make the greatest progress will appear to suffer most. Hence the facial division is always observed, in the individual affected with rickets, to be relatively smaller than the cranial: so that while the latter seems of average natural size, the jaws, both upper and lower, are peculiarly diminutive, and the prominences of the face corresponding to the frontal sinuses and cells of Highmore are imperfectly expanded. And here it may be noticed, in reference to this contrast, that the forehead—the supposed special seat in the brain of the intellect—is particularly prominent, and appears remarkably capacious, in most persons deformed by rickets; and the appearance is not unfrequently regarded as a sign of superior mental quality in the individual who exhibits it; but the evidence of the callipers will show that no real enlargement of the cranium exists; and it will be concluded that the prominence and expansion of the frontal region only appear great, because the face in juxtaposition is abnormally little.

Fig 964.



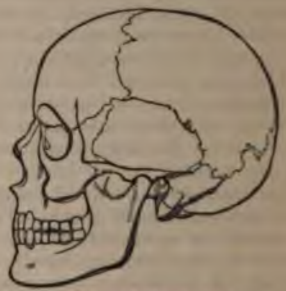
Skull of infant at birth.

Fig. 965.



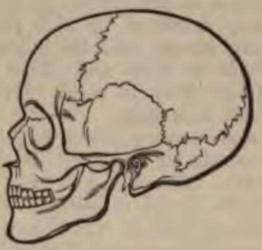
Skull at about six years of age.

Fig. 966.



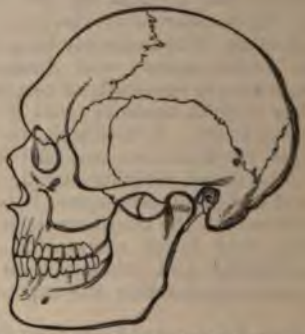
Normal adult skull.

Fig. 967.



Skull of adult rickety person.

Fig. 968.



Skull of Byrne, whose skeleton is in the College of Surgeons, and whose height was eight feet.

Let it be supposed, on the other hand, that the rate of growth has been accelerated, it may be expected that the relative proportions of the two divisions of the head will be the reverse of those seen in the head of the rickety individual. As the configuration of the latter bore distinct traces, in the large cranium and small face, of the pristine form of the child, the configuration in a person whose growth has been carried on at an ultra rapid speed, as for example in an individual of gigantic height, will present the signs of the adult form in an exaggerated degree. The principal additions will be observed in the facial division; the upper and lower jaws will be greatly enlarged, the cellular compartments in the bones of the face, which, at the same time that they are appendages of the vocal organ, contribute large surfaces exteriorly for the attachment of muscles, will be expanded; and the result will be that while the cranial division has remained relatively stationary and small, the facial will have acquired extraordinary bulk. Further, it will be perceived that the frontal region, instead of being broad and prominent, as in the rickety skull, will appear shelving and low. That condition, however, is a consequence merely of inordinate increase in the size and expansion of the frontal sinuses.

As the frontal sinuses assist in modifying the form of the forehead, they have a remarkable influence also, in common with their allied cavities in the upper maxillary bones—the cells of Highmore—of keeping the orbits (both of persons in whom the growth has been interrupted, and in whom it has been over-active) of a uniform size. When the eyeball, the chief occupant of the orbit, has completed its growth, at a comparatively early age, the other contents likewise attain their full size, and they do not vary in bulk afterwards; hence the cavity may continue of the same dimensions throughout life. Now, it is found that the orbits, thus adapted to their contents, remain constant in capacity equally in skulls distinguished for the smallness and for the great magnitude of their facial divisions. To verify this, measurements were made of the orbits in a numerous set of skulls, which differed from each other in the relative dimensions of the bones of the face, according to the diversity of the rate of growth. These measurements were taken along the lines of the several diameters, longitudinal, transverse, and antero-posterior; and the results showed that their lengths were the same, with scarcely any appreciable difference, in all the skulls. The explanation of the uniformity is obviously as follows: the frontal cells are situated over, and the maxillary cells under, the orbits; so that the floor of the former is the roof, and the roof of the latter the floor, of the respective orbits. Again, the cells are either imperfectly developed, or developed to a great extent, according as the growth of the individual has been below or above the average rate. Being of diminutive capacity in the skulls of persons stunted in their growth during childhood—as in rickety individuals—the cells occupy a small space above and below the orbits, and the cavities of the latter, therefore, retain the standard dimensions; but being, on the other hand, of large capacity in the skulls of persons whose growth has been abnormally active, as in tall overgrown individuals, the cells encroach, as it were, by their magnitude on the walls of the orbital cavities, and subdue them to the standard dimensions.

Reverting now to the subject of diagnosis, and the question whether lateral curvature depends on a morbid condition of the osseous system identical with or analogous to rickets, for its origin, it may be alleged that the opinion derives no support from the preceding observations. Evidence is altogether wanting to show that, while the curvatures of the spine—which are the only apparent effects of the supposed softening of the bones—are in the course of forming, there is any arrest of the general growth like what takes place in the deformity from rickets. Independently of the changes consequent on the incurvations of the spine, the relative proportions of the figure are natural; the lower extremities are developed to their full extent, in length, breadth, and weight; and in the head there is a proper proportion between the cranial and facial divisions.

What chiefly makes it important to decide the question whether lateral curvature really depends on a softening of the bones, such as that to which rickets gives rise, is the consideration of the condition of the pelvis in a female patient. When rickets invades the osseous system, the most formidable effect it produces is deformity of the pelvis, the circle of bones through which the child is propelled in the act of parturition. But it has been formerly stated that, among persons affected with lateral curvature, the proportion of females so greatly exceeds that of males that the deformity might be regarded as almost peculiar to women. Accordingly, if lateral curvature be supposed to be a consequence of rickets, the inference will be drawn that all female patients so deformed will have been exposed to the danger of having their pelvis also deformed.

In his work on Distortions of the Spine, Mr. John Shaw opposed the view that either rickets or any analogous morbid affection of the osseous system had any share in causing lateral curvature. And he stated his opinion, founded on the examination of numerous specimens of distortion preserved in different collections, that the pelvis would not be found deformed, unless there were evident signs of the bones of the lower extremities, especially the tibiæ and fibulæ, which bear the greater amount of the pressure of the superincumbent weight, having become incurvated.[1]

But the preceding observations have shown that, although degeneration and softening of the osseous system, with consequent incurvation of the columnar bones in particular, are prominently marked features of rickets, yet they are not the only important ones which

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[1] It had been assumed, in a work of authority published a few years previously, that general softening of the bones preceded the formation of lateral curvature; and the practice which then prevailed of treating cases of the deformity by the employment of heavy iron supports, resting on the hips, was condemned, because it was considered that they gave rise, by their weight and compression, to deformity of the pelvis. See Lectures on the Bones and Joints, delivered before the College of Surgeons, by James Wilson, 1820.

characterize it or bear upon the question of the condition of the pelvis. It has been seen that, owing to rickets being a disease of childhood, and its checking or stopping the growth, it prevents that change in the relative proportions of the frame, by which the figure of the child—independently of bulk or stature—is distinguished from the figure of the adult, from being fully carried out. Now, the interruption tells with especial effect on the pelvis. No part in all the skeleton undergoes such a great transition, from being relatively small to being relatively large, between the two epochs of infancy and adolescence, as that girdle of bones. When the growth, therefore, is arrested, it is to be expected that the pelvis will be diminished in bulk throughout its whole extent, in proportion to the rapid rate at which it would have increased but for the stoppage. Accordingly, by measuring several pelves of skeletons
rickets, and others of s
and then comparing the
tained that the number wh
the average of the united
in the rickety pelves was
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narrow.

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patient affected by ricket
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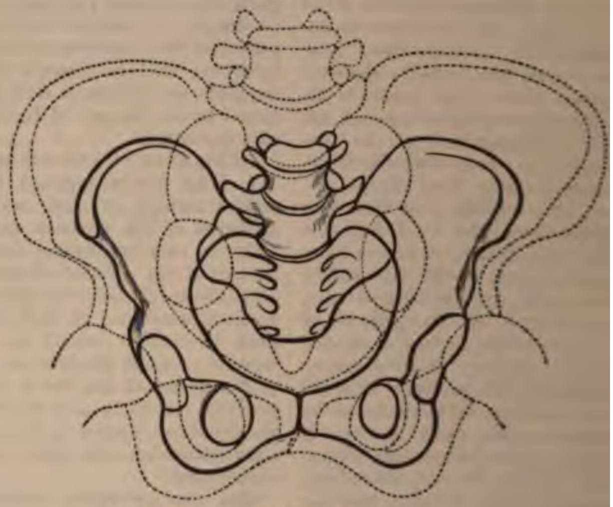
pelvic canal, from the so

Fig. 969.



Comparison of normal and rickety pelves.

formity of its walls; 2, narrowness of the canal, from defective growth of the walls.

The figure in the woodcut, representing a normal pelvis in dotted outline, was drawn on scale, from one taken from the body of a full-sized healthy female. The figure in bold outline, a pelvis of small size, represented for comparison as if placed within the bounds of the other, was drawn on scale likewise, from one removed after death from a woman whose body, both in its general configuration and the distortion of the limbs, showed unmistakable signs of rickets. It will be remarked that few and slight traces of deformity are perceptible in the pelvis of the rickety patient; yet her death took place in child-birth from difficult labor; embryotomy had to be p
she died in a few days af
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[1] Patients deformed from
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Prognosis.—In anticipating the issue of a case of lateral curvature, it should be remembered that the flexibility of the spine, in youth, diminishes yearly. Now, as the greater the flexibility, the greater is the proneness of the deformity to get worse if neglected; and as the greater the flexibility also, the more favorable is the condition of the spine for effecting a cure, it follows that an early commencement of treatment is urgently necessary, both for preventing increase of the curvatures, and for rectifying them. Again, as rigidity of the column increases with years, curvatures of old standing are less likely to become worse than those of recent formation; and, for the same reason, the prospect of success from treatment is more distant in them.

Lateral curvature of the spine in a young girl, however slight, ought always to be regarded as requiring immediate care; the patient ought not to be left to the chance of her "growing out of it." When the column leans habitually, even to a trifling degree, to one side, the superincumbent weight ceases to be supported in the line of the vertical axis, and falls chiefly on the oblique processes of the side to which the patient inclines; these rapidly undergo absorption, and in proportion as they are diminished, the curvature gets progressively worse.

Owing to the spine at the lumbar region possessing greater flexibility than at the dorsal, a curve situated in the former is more easily rectified than one in the latter. On the other hand, from the dorsal vertebræ being encumbered by the ribs, which early participate in the distortion, the difficulty of overcoming a curvature there is increased. Moreover, in extending the column, a better purchase can be obtained for mechanically operating on the lumbar than the dorsal curve. Furthermore, it has been shown that, in consequence of the rigidity of the dorsal portion, absorption of the compressed vertebræ proceeds with great activity, so that the curve tends to be rapidly aggravated.

For testing the stability of the spine and judging of the efficacy of the treatment, the best mode is, first, to put the patient's body on the stretch by extension and counter-extension; then, to measure the height at its fullest, with accuracy; when that has been done, let her lounge at her ease for some time; lastly, let her height be measured after the spine has had time to sink down; the loss observed on comparing the two measurements will indicate the strength or weakness of the column.

Treatment.—By reclining in the supine position on an inclined board, the head and armpits being adequately secured to prevent the patient from sliding down, and the lower part of the body left loose, or with some mechanical appliance added to increase the traction, extension and counter-extension may restore the spine, more or less effectually, to its straight position. The benefit anticipated is, that, in course of time, when the vertebræ and connecting structures have been kept sufficiently long in their approximately normal situations, they will become reinstated in them by the influence of growth.

It cannot be doubted that this plan of keeping a patient confined on the back for a long period would prove more efficacious than others. But there are sundry objections to adopting it, especially as an exclusive mode of treatment; the chief of these are, the injury to the patient's health, which would probably follow the prolonged confinement; the debility of the muscles that would ensue from want of exercise; the comparative seclusion; and the interference with the pursuit of education. Accordingly, it has been a constant aim to find a fitting substitute in spinal supports of various kinds. One of the chief recommendations of these is, that they allow liberty to the patient to walk or sit at pleasure, in common with others; and for that advantage she willingly submits to the irksomeness of wearing them. But their efficacy is not to be relied on. The endless variety of apparatuses of the sort invented, tried, and abandoned, shows the difficulties and disappointments connected with them. The main obstacles to applying mechanical supports successfully, proceed from its being impracticable to accommodate the rigid materials composing them to the flexible and yielding form of a young person. Whatever ingenuity may be exhibited in the construction—in forming a secure point d'appui at the hips—in introducing contrivances to hoist up the column, or to unbend it—inserting props for strength, or compresses to push the gibbous ribs inward—it is liable to fail; because, while the metallic instrument retains one unchangeable form, the compressible, flexuous body, encased within, is incessantly varying its position and shape. The remark applies particularly to cases of incipient distortion, when the patients are about fourteen years of age. Later in life, when the vertebræ and ribs are more consolidated, a better purchase can be obtained for the centres of bearing. But when that time has arrived, the curvatures have become too stiff and unyielding

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writer of this article, in the Med.-Chir. Trans., vols. xvii. and xxvi.: also others on the same subject, in the Lond. Med. Gaz. for 1835, pp. 45, 349.

for treatment of any kind to be serviceable.

[The application of an encasing splint while the child is suspended, as proposed by Sayre, has in great measure revolutionized the treatment of these cases, and has made it possible to accomplish much more for them than could be done at the time Mr. Shaw wrote his exhaustive article.

A plaster bandage, or, better, a sole-leather jacket, fitted upon a cast of the extended trunk, will be found a most important aid in the treatment of these cases. A full description of this apparatus will be found in its appropriate place in the articles on DISEASES OF THE SPINE, and on MINOR SURGERY.]

Physical exercises are essential adjuncts of the treatment. They accomplish various beneficial objects; besides their common use in strengthening the muscles, and preserving the health, they have the indirect effect (see p. 884) of increasing the density and solidity of the bones, and adding to the tenacity and power of resistance of the ligaments of the joints. Moreover, they may be made available for stretching the contracted parts in the concavities of the curves; and by loosening the connections of the vertebræ, they will give greater facility to straightening the column by extension. But it would be vain to suppose that exercises by themselves could effect a cure. They can only be serviceable as auxiliaries.

It appears that, in order to do most justice in the treatment of cases of lateral curvature, the best course is to combine in various proportions, according to the nature of the deformity, and in the age of the patient, parts of the three different plans briefly described. In a certain set of patients, remarkable for the weakness and suppleness of their frames, it is obvious that stiff and heavy spinal supports would not be applicable, and a preference would be given to employing the method of reclining on the inclined plane—looking forward to the patient becoming, ere long, stronger, and capable of wearing corsets of simple construction, to diminish the period of confinement on the board. Again, in every case, it ought to be considered a necessary addition to have proper systematic exercises, of the nature of calisthenic or others, regularly performed daily. Experience shows that, when the time of reclining on the plane is broken into at due intervals, by active exercises, indoors and out of doors, the health, instead of being impaired, decidedly improves under the conjoint treatment.

It might, perhaps, be thought that some detailed description should be given here of various kinds of extending-beds, apparatuses for exercises, corsets, and sundry other equipments used in the treatment of lateral distortion. But an account of them would occupy much room; and without numerous diagrams, inconsistent with the scheme of the present work, it would scarcely be intelligible. Information concerning them must be sought in books which treat specially on the subject.

PIGEON-BREAST DEFORMITY.

This distortion consists in a protuberance of the sternum and cartilages, by which the antero-posterior diameter of the chest is disproportionately enlarged, and a gibbosity produced. Corresponding to the line of junction of the cartilages to the ribs, a sulcus on each side forms a boundary to the projection. The deformity is not inconsistent with symmetry in other parts of the chest, and the frame generally. It is equally common in both sexes. When confirmed, the heart and lungs are somewhat altered in relative position in adaptation to the figure; but their actions are not perceptibly deranged. The deformity is more frequently observed in the young, from six to twelve years of age, than in adults, which leads to the inference that patients commonly outgrow it.

Causes.—The writer has not found, in any work treating on the subject, a satisfactory explanation of the mode in which pigeon-breast deformity is produced. A view that appears to solve the problem was suggested to his mind when observing the movements of the chest in a child laboring under dyspnœa with impending suffocation, and for which tracheotomy had to be performed. The patient had previously a flat chest, of ordinary shape. By the stethoscope it was ascertained that scarcely any air entered the lungs. What chiefly attracted notice was the imperfect manner in which the thorax underwent expansion at each act of difficult inspiration. The clavicular and upper sternal regions were protuberant and fixed; the respiratory movements were confined to the lower three-fourths of the thorax. But instead of the ribs which moved dilating to their full extent when inspiring, their sternal ends were drawn inward. And as that sinking took place along the line of junction of the costal cartilages with the ribs, from the third or fourth downward, and chiefly near the lower margins of the chest, a depression of the antero-lateral regions was the result. Now, the appearance thus presented resembled so greatly the falling-in of the ribs, and protrusion of the sternum seen in pigeon-breast deformity, that the conditions seemed identical. The constriction disappeared at each act of expiration. Thus, contrary to normal breathing, a partial contraction of the thorax occurred at every inspiration and a partial expansion at every expiration. Similar phenomena have been frequently observed since.

Taking into view the great flexibility of the walls of the chest in childhood, it may be understood how they should be subject to imperfect expansion, in the manner described above, when the air, through any cause, is prevented from fully distending the lungs. In the act of inspiration two distinct operations are performed: first, to create a tendency for a vacuum, the thorax is expanded; next, the weight of the atmosphere causes air to enter the lungs. By the free admission of that air into the interior, a balance is established between the pressure of the atmosphere on the outside, and that on the inside, of the chest; consequently, although the parietes may be thin and pliant, their movements can be performed with perfect facility. But quite a different state may be expected when the expansion of the chest is unaccompanied with a corresponding dilatation of the lungs. For example, in the case of a child whose larynx is closed so as to impede the entrance of air, it is obvious that, if the thoracic walls could be expanded, there would be nothing to counterbalance the weight of the atmosphere without. In such cases the chest is incapable of being expanded, or it is expanded imperfectly. To the best of their ability the intercostal and external accessory layer of respiratory muscles elevate and widen the area included within the sphere of the ribs; the diaphragm also acts on the free margin of the chest, downward and concentrically, to increase the vertical diameter; but the pressure of the atmosphere interferes with their effect. And that pressure from without tells mostly on the weakest parts of the compages. These are, unquestionably, situated in the line of junction of the costal cartilages with the ends of the ribs. Accordingly, it is there that the chest is principally indented; and this indentation leads to the sternum being abnormally protuberant.

Taking these observations into view, they show that, when the chest, as in childhood, is highly flexible, any cause that obstructs the entrance of the air into the lungs may lead to changes in its figure resembling pigeon-breast deformity. In the example which has been given, the source of the difficult breathing was of a kind to threaten life. But it can be conceived that a cause acting in a similar manner, yet of relatively slight importance as regards health, might imperceptibly, and after a considerable lapse of time, bring about an identical condition of the chest. If a child suffer from chronic enlargement of the tonsils, the encroachment of the glands on the glottis may diminish the calibre of the tube to such a degree that the air will enter with difficulty, so as to fill the lungs incompletely; and the long continuance of the dyspnœa thus produced may lead eventually to the chest becoming of the pigeon-breast shape. This idea is supported by a remark of Dupuytren's, that patients with this deformity are frequently found to have suffered at one time from enlarged tonsils.[1] The writer had under his care a boy, three and a half years old, in whom both tonsils were so large that they gave rise to dyspnœa, aggravated at nights so as to threaten suffocation. The air entered the lungs imperfectly, and it was remarked that the front of the chest was gibbous. The glands were almost beyond sight, having been propelled downward, as it appeared, from getting within the grasp of the constrictors of the fauces. Some days after a partial excision, the patient nearly expired in a fit of suffocation, and was restored by tracheotomy. Subsequently the tonsils were effectually removed, and the patient perfectly recovered. It was then particularly noticed that the front of the chest subsided to its natural level, and that all appearance of deformity was effaced. Further observations may, perhaps, show that other morbid changes, capable of interrupting the entrance of air into the lungs, have the effect of producing the gibbosity.[2]

Treatment.—Having stated that pigeon-breast deformity exhibits a tendency to spontaneous cure, it may suffice to refer briefly to certain measures which will, perhaps, assist Nature in her work. A truss, like that worn for umbilical hernia, has been found of service, or the patient, in addition to wearing the truss, may be directed to lie for several hours daily, at divided times, flat on his back, having a bag of shot, of suitable weight, laid on his breast. Most benefit, however, is to be anticipated from athletic games; and rowing may be specially mentioned.

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[1] Répertoire d'Anatomie et de la Physiologie, tome v., p. 112.

[2] See a paper on "Deformity of the Chest from Dyspnœa," by the writer, in London Med. Gaz., Oct., 1841.

SURGICAL DIAGNOSIS AND REGIONAL SURGERY.

By T. Holmes, Esq.

Revised by John H. Packard, M.D.

Surgical Diagnosis.

Diagnosis is the term used by physicians and surgeons to express the scientific opinion, or theory, which they form of each case presented to them in practice. The art of diagnosis may justly be said to be the main object of the study of medicine; as being the end to which all its theoretical parts converge, and the source from which all its practical rules proceed. The substances comprised in the *materia medica* are indeed innumerable, the varieties of surgical appliances and operations are infinite; and a competent knowledge of them is of course one of the fundamental requisites for a good practitioner. Still it is none the less true that the successful application of every one of those means depends upon a correct diagnosis of the morbid action which it is intended to subdue. Hence, a complete treatise on diagnosis is almost equivalent to a complete treatise on medicine; and to endeavor to write fully on surgical diagnosis in this place would be little less than to re-write the whole of the preceding work. But the student of the foregoing pages will, it is hoped, find there all that is necessary to guide him in the emergencies of practice, as far as a book can assist him. The object of what follows is rather to point out the general principles on which surgical diagnosis is founded, and to endeavor to impress on the student the great importance of a full, and above all a methodical, plan of taking notes of cases. To no part of a surgeon's duties is less attention given than to "taking cases;" and yet it is of great importance towards acquiring the power of correct diagnosis, a power which is the chief requisite for successful practice. Without in any respect undervaluing the triumphs of operative surgery—in fact, while confessing that the successful performance of a great operation is the highest pleasure which the pursuit of surgery affords—we may yet admit that many men of inferior powers have been bold, handy, and successful operators. But the attainment of great skill in diagnosis requires a combination of natural and acquired gifts, which are not within every one's reach; an amplitude of information not to be afforded by any single experience, and which, therefore, can only be got by extensive study of surgical literature; a familiarity with morbid symptoms and appearances, and a readiness in combining and in interpreting them, which book-learning is quite unable to give, and which can be acquired only by long and careful study of disease at the bedside; and finally, and above all, a logical power of mind, which neither study nor experience can confer, but which must be born with its possessor.

In the few pages which are here at my disposal I can only hope to give a short exposition of the most elementary and universal principles of surgical diagnosis, with a few familiar illustrations of each topic, chiefly selected from the foregoing essays. I shall then proceed to illustrate the most important element of surgical diagnosis, viz., the anatomical examination of the diseased part, by some account of the more familiar surgical affections as they appear in the various main regions of the body.

All diagnosis, both medical and surgical, rests on three chief elements, viz., 1st, the history of the patient and of the disease previous to the time of examination; 2d, the symptoms of the disease at that time—*i. e.*, the functional disturbances which it has produced; 3d, the physical examination of the diseased part. These elements are common both to medicine and surgery; but while medical diagnosis relies mainly on the two former, and chiefly on the second (except in diseases where auscultation plays the chief part), surgical diagnosis, on the contrary, is mainly concerned with the third; and hence its greater ease and greater certainty, since it deals more with matters cognizable by the senses. This, too, explains in some measure the great part which anatomy plays in scientific surgical education.

In order, therefore, to cultivate the art of diagnosis with success, the surgeon must be accustomed to investigate the previous history of the patient and of his disease both fully and accurately; he must then collect together the symptoms, and compare them with those of the various known diseases to which they point; he must be thoroughly conversant with every kind of physical examination, and especially by the sense of touch; nor, after all, will he be a master of diagnosis unless he has sufficient reasoning powers to see all these particulars in their proper relative proportion, and sufficient caution and deliberation to weigh them sedulously against each other. We see mistakes in diagnosis committed daily—there are few of us who have not to look back with mortification on many of our own: but most men's experience will bear out the statement, that the great majority of them have been errors of *haste*, due in great measure to a pernicious habit, which the practice of our public institutions tends to create. There a great number of patients are to be attended to in so short a space of time that it is physically impossible to go through the successive steps mentioned above, of inquiring into the history, the symptoms, and the appearances of each one as he presents himself; and the mind is too fatigued by the constant succession of varying phenomena to be able to follow out the reasoning process which is essential at the end of those successive steps. Hence we acquire the habit of leaping to a conclusion in the diagnosis of our own cases, and of acquiescing in the opinions of our colleagues on theirs, without submitting to the labor of examining them methodically for ourselves. Such a habit is, I am persuaded, one of the worst results of our hospital system, and particularly of the out-patient department of it, through which all the officers of hospitals now pass at the beginning of their career. A man who is compelled to see a hundred patients in a couple of hours (and this is hardly an exaggeration of the pace at which the machine is driven) acquires the habit of judging of the case from the first glance, and judges usually with correctness. No doubt much rapidity and decision is obtained by this practice, and there are cases in surgery where these are the qualities chiefly required; but there are many others in which errors can only be avoided by great patience, and habits of this kind produce a character of mind to which patience is a stranger. Hence it is very desirable for students and young practitioners to practise the investigation of cases, whenever it is possible, upon a methodical plan, and to commit their notes of the cases to writing. This is of course unnecessary in many of the simpler surgical cases, but is almost indispensable in some of the obscurer ones, and is a useful corrective of the hasty practice which I have thought it my duty to reprehend. It would, however, be a grievous mistake to suppose that haste is the only danger to diagnosis; and accordingly, in dwelling on the main considerations relative to each of the three elements of surgical diagnosis, the main sources of error connected with them will also be touched upon.

I. *History.*

The first main source of diagnosis, viz., the history, comprises all the facts relating to the patient's ordinary circumstances, such as age, sex, and occupation, which are likely to throw light on the disease to be diagnosed; the circumstances under which the disease first showed itself, its alleged cause, the particulars of the first departure from health, the date at which the patient first sought medical advice, the nature and effect of the treatment adopted, and the progress of the malady up to the time of examination. These particulars are furnished by the patient himself; but they can in many cases be checked or corroborated by the records which the disease has left on the body, in the shape of the marks of old abscesses, the distortions produced by inflammation of muscles, the atrophy of disuse, the results of old disease of joints, etc.

Let us consider these particulars somewhat more in detail.

Age.—The patient's age is one of the most essential particulars in forming a diagnosis of the affection. That this is so at the extremes of life every one is aware. Thus, for instance, in the affections of the hip-joint. If it be an injury of the hip that is under examination, we know that intra-capsular fracture rarely occurs except at an advanced period of life, and never in youth; that dislocation is very rare in childhood; and that fracture of the cervix femoris within the capsule is a comparatively common effect of slight violence in old people of relaxed fibre. If it be a disease of the hip which is presented to us, we at once consider that in childhood the so-called strumous disease tending to, or depending on, chronic caries of the bones is exceedingly common, while acute abscess is rare; that in middle life the inflammatory affections which are excited by injury become more common; while at a more advanced period the main affection of the hip is that disease which was erroneously supposed to be peculiar to old age—chronic arthritis—the "malum coxæ senile" of our older authors.

Amongst the numerous instances of the importance of paying attention to the age of the patient in forming the diagnosis, we may refer to the following examples taken from the previous pages of this work. In inflammatory affection of the cheek occurring in childhood, the presence or the imminence of that formidable affection called cancrum oris would be suspected, since this disease rarely occurs after ten or before one year of age (Vol. I., p. 356); while in later life, rodent ulcer, lupus, and epithelioma are the prevailing affections. In the examination of these latter forms of destructive ulceration, it must be an important element in the diagnosis that rodent ulcers generally occur in the later half of life, and lupous in the earlier (Vol. I., p. 375).

In affections suspected to be hysterical the period of life is of course of the utmost importance in diagnosis, since, though such affections occur to women at advanced periods of life, they are far more common in youth (Vol. I., p. 590).

In injuries, if a distinction is to be drawn between dislocation and separation of the epiphysis, the period at which the latter point of bone is developed, and is joined to the shaft, must be steadily borne in mind (Vol. I., p. 482); and in disease of the bones in childhood the same particular is of very great importance (Vol. III., p. 197).

These are a few of the many examples which might be cited of the importance of paying attention to the age of the patient in forming the diagnosis. But errors may easily be committed if more stress be laid on this particular than it deserves. Thus Sir A. Cooper first taught the now admitted fact that intra-capsular fracture of the femur is an injury peculiar to advanced age; and he very justly dwelt on this fact, and on the indisposition of the fracture to bony union, and consequently the impropriety of treatment directed to promote union by enforced rest in bed and confinement in splints. But in proceeding so far as to teach that nearly all fractures of the neck of the femur in old people are of this class, and therefore insusceptible of union, there is no doubt that he exaggerated the influence of age; since it is now demonstrated that most fractures of the neck of the bone, even at an advanced period of life, are partly extra-capsular (Vol. I., p. 939).

Sex.—The importance of sex in the diagnosis of surgical affections is not limited to those of the genital organs and mamma. Other organs, such as the thyroid body, are notably modified in their affections by the influence of sex (Vol. III., p. 79); but besides this, the course and the character of all manner of diseases is different in males and females; and in the latter the strange sensibilities of the uterus lead to a train of symptoms most vaguely indicated by the term "hysterical;" a term which is the only one we can use, though it frequently conveys a false impression of fiction or exaggeration in cases where the symptoms are as real as those which depend on organic disease, though they are not dangerous to life. Unless such sexual peculiarities were kept constantly in view, the daily-recurring, and quite innocent, painful affections of the limbs, the chest, the head, etc., would be constant sources of needless anxiety.

Errors in diagnosis, however, proceeding from too readily attributing the diseases of females to hysterical causes, are so very common, that the surgeon must be constantly on his guard against them. This is so ordinary a matter of experience that it is needless to cite many instances. The mistake occurs chiefly in the early stages of deep-seated diseases of the bones; as in the case of a young woman, of hysterical temperament, admitted into St. George's Hospital for deep-seated pain about the pelvis. The disease, which was long treated as hysterical, then revealed its true nature by the formation of abscess; and death from caries of the sacro-iliac articulation ultimately ensued.

Occupation.—The patient's occupation is sometimes, although not very often, a matter of primary importance. Thus in disease of the jaw, the fact of the patient being a worker in phosphorus would go a great way towards the establishment of the diagnosis. In diseases of the bursæ again, the patient being a tailor, a miner, a housemaid, would render the diagnosis more secure in case of a tumor situated over the fibula, the olecranon, the patella. Still more frequently the occupations connected with beer or spirit-drinking (potmen, butlers, draymen, etc.), and those very laborious trades in which the habitual drinking of great quantities of beer is regarded as almost a matter of course (navigators, coalwhippers, etc.), furnish a very valuable indication for the diagnosis and prompt treatment of the early symptoms of delirium tremens, so apt to follow injuries in such persons (Vol. I., p. 581). In some rarer cases the patient has been exposed to the usual influences of particular trades, though his occupation is different; so in Earle's case of the gardener who contracted soot-cancer on his arm from his habit of carrying a bag of soot to use in his garden.

Social condition.—The married or single condition should be noted both in men and women; and in the latter the number of pregnancies and of children, together with the causes, if known, of abortion. In the case of single persons it is often useful to know whether they are in the habit of illicit intercourse, and if so, whether such intercourse is promiscuous or not; and in all cases it is very desirable to be informed of any attacks of venereal disease, and its sequelæ.

Habits. — This brings us to two still more important matters in the patient's history, viz., his habits and his previous diseases. The previous habits of the patient very often account in a great measure for the symptoms which he presents, being the indirect, even if they are not the direct, exciting cause of his disease. It is hardly necessary to do more than allude to the importance which known habits of prostitution would have on the diagnosis of disease (such as a skin-eruption) suspected to be syphilitic; of drunkenness, on that of restlessness, nervousness, and tendency to delusion; of masturbation, on that of peculiar nervous symptoms.[1] But besides these extreme and familiar instances, there are many others in which a candid confession on the part of the patient might assist the surgeon's diagnosis most materially.

Closely connected also with the patient's habits of life is the character of his mind and his habit of body, both of which particulars often form important elements in the diagnosis, and materially assist the surgeon in determining on the reality of pain, the exaggeration of accounts of previous disease, etc.

Previous diseases. — The previous diseases must be carefully noted, since they often tend to throw light on the constitutional predisposition, and in the practice of surgery are perhaps of equal importance in accounting for local weakness and predisposition to disease. For an illustration of this we may refer to the diagnosis of cutaneous eruptions, or of affections of the bones, in which the history of a previous syphilitic affection, or of a strumous disease in childhood, will often be a main point in the diagnosis. This head will include of course the constitutional peculiarities which the patient may manifest.

But in these three preceding particulars, perhaps more than all others, great care must be taken not to exalt what is, after all, a mere presumption into an absolute indication. Very many cases are wrongly diagnosed and treated, in consequence of forgetting the obvious truth that every disease occurring in an hysterical woman is not hysterical, nor every affection in a syphilitic patient syphilitic. Strumous children are not insusceptible of acute inflammatory affections, and these are often signally benefited by active treatment. Even in a cancerous patient we may meet with an innocent tumor, as is proved by the frequent occurrence in such persons of fibrous tumors of the uterus.

Hereditary tendencies.—Closely allied to the previous diseases which the patient has himself suffered is the tendency to disease which he has inherited from his parents. In some cases this branch of the investigation is easy. Many families labor under hereditary tendencies to phthisis, cancer, or insanity, which are notorious, and are known to their friends as well as to themselves; but in many cases, and in diseases which are not so open to observation, it is otherwise. The most striking instance is congenital syphilis, in which not only is it extremely difficult to obtain evidence from the person who is really in fault, but also the contagion may even proceed from an innocent person; as, for instance, a perfectly chaste woman who has borne children to a syphilitic husband, and thus has contracted the constitutional disease, may bear syphilitic children to a second (sound) husband; or to take a less extreme case, a healthy wet-nurse may be infected by her nursling and carry the disease into her own family, though both she and her husband may have been perfectly free from any known exposure to syphilis.

Of the great importance in diagnosis of the knowledge of the patient's constitutional tendencies, one of the most striking examples may be drawn from the essay on ULCERS, Vol. I., throughout the whole of which this point is strongly dwelt on.

When all these preliminary subjects (which constitute the history of the patient) have been investigated, and duly noted, the examiner arrives at the history of the disease properly so called. This embraces the following main particulars: the alleged cause, the duration and onset of the disease, its course up to the time of examination, the nature and effect of the treatment which has been adopted, and some other miscellaneous circumstances.

The alleged cause.—The knowledge of the cause of a disease is of primary importance for its diagnosis. Often, indeed, it is in itself sufficient to establish the diagnosis, as in the instance above cited of the phosphorus-disease, where the cause is the patient's occupation combined with caries of the teeth. But it is often one of the most difficult circumstances in the whole investigation to decide accurately. There is an almost invincible tendency to ascribe the disease to some accidental injury which the patient may have suffered, especially if that injury have acted only, or mainly, on the part affected; and it is often impossible to say whether this causal connection is real or imaginary. Thus, to take a familiar instance, morbus coxarius in children is almost universally attributed by the mothers of the children to a blow, fall, or sprain, and by their medical attendants to the strumous diathesis, without which it is said that the local violence would have been harmless. Which party is most in the right? It is very difficult to say; yet the point is very important to the diagnosis. If the disease be due to local violence in a child otherwise healthy, its character may be diagnosed as inflammatory, and local treatment may be expected to cure it; and so in the last resort, provided that so severe a measure be necessary, the excision of the whole of the diseased parts may often be expected to succeed; while if the affection be diagnosed as a constitutional one, the surgeon could hope little from local measures. I have selected this instance in order to afford myself an opportunity to put on record my conviction that the diseased joints of children are too often set down hastily as "strumous," when in reality the affection is in no manner connected with the strumous constitutional taint.[1] It is very well known how frequently disease comes on, even after the lapse of a considerable time, in parts which have been the seat of injury (Vol. I., p. 386); but it is extremely difficult to decide whether this is due to a real connection, or is a mere coincidence.[2] But the difficulty of deciding as to the action of an injury is not unfrequently complicated by the doubt whether the injury has really occurred or no. For instance, how very often young female children are said by their parents to have contracted gonorrhœa from illegal intercourse, and how seldom is anything of the sort proved. If every such story was credited by those who see much of infantile leucorrhœa, they would get into constant trouble and disgrace. (See the essay on SURGICAL DISEASES OF CHILDHOOD.) Besides such sources of deception, which rest upon honest mistakes (for the parents usually believe the disease to be so caused), the occasions for wilful deception are numerous. Many surgical diseases and injuries are caused by illegal or disgraceful acts, which the patient will not disclose, whatever may be the hazard of concealing from the surgeon the cause of his ailment (see the article on APNŒA, p. 88). Instances of such purposed concealment come too often under the notice of every surgeon of experience, not to make them very cautious in receiving their patient's statements as to the alleged causes of disease; and therefore it is hardly necessary to quote instances of errors proceeding from a too ready acceptance of this part of the history. Perhaps one of the most fertile sources of these errors is the diagnosis of affections of the larynx in children, as to the presence or absence of a foreign body (Vol. I., pp. 707 and 708).

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[1] See a case by Mr. Hilton, in his Lectures on Rest and Pain, p. 268.

Still, the cause of the affection plays a great part in surgical diagnosis; in fact, it sometimes forms the basis of our classification of disease. An instance of this is afforded by delirium tremens. There are other conditions of delirium which it is otherwise difficult to distinguish from the "delirium è potu," but which occur in persons known to be temperate. Nevertheless it is justly held advisable to classify these apart (that is to say, to diagnose them as independent diseases), and to restrict the term delirium tremens to the delirium of drunkards (Vol. I., p. 581). The nature of many diseases was unknown till their exciting cause was discovered— a striking instance of which is afforded by glanders (Vol. I., p. 441); in hydrophobia also the knowledge of the cause would materially facilitate the diagnosis of the early stage of the disease (Vol. I., p. 434).

Inflammatory and other affections are often found to depend upon causes very far removed at first sight from their visible effects, but connected with them by nervous sympathies, which a knowledge of the anatomy and physiology of the nervous system can alone explain. In such cases the diagnosis is the more important, since on it depends the cure of the effect by the removal of the cause. The subject is illustrated by what is said at Vol. I., p. 88, as to local inflammation excited by reflex or direct impressions on the nerves of the part inflamed, and by the instances quoted at Vol. I., p. 352, of the effects of deprivation of nervous power in exposing the part to gangrene.

Duration.—The duration of the disease is another point of the greatest importance in diagnosis, particularly with respect to the malignancy or innocence of tumors, to the inflammatory or chronic nature of diseases, and to a thousand such questions of everyday practice. In the diagnosis of the various forms of tumor in the groin and scrotum, the duration of the complaint up to the time when the tumor attained considerable dimensions is a point of extreme importance. The sudden formation of hernia, the gradual descent of psoas abscess, the slow growth of hydrocele, the rapid formation but slow increase of hematocele, the steady and rapid growth of malignant tumor of the testis, the slow increase and frequently the complete suspension in growth of varicocele—are among the points connected with this part of the subject which have been dwelt on in the preceding pages.

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[1] Mr. Bryant would repudiate the term "strumous disease" of a joint altogether (Surg. Dis. of Children, p. 123). This may be going a little too far; but the term has no doubt been much abused.

[2] It is well known that Sir B. Brodie's death was caused by malignant disease of the shoulder, and that the same shoulder had been the seat of dislocation some years before; but considering how often shoulders are dislocated, and how rarely any such disease follows, it is very difficult to believe that we have more in this instance than a casual coincidence.

Yet here again errors may easily be made. Thus some innocent tumors grow more rapidly than some cancers do; and in all tumors we must remember that the growth may have attained a large size before it has been noticed. Sometimes the growth of cancer is suspended during even a very considerable time (Vol. I., p. 282). Again, in the course of a chronic affection, acute inflammation may occur; and the duration of the disease may be greatly influenced by the patient's time of life.

Course of disease.—The course of the disease, from its onset up to the first visit of the patient, is of great importance, when it can be clearly traced; and so to a still greater degree is its course after the patient has come under treatment. There are not a few diseases of which no skill can enable the surgeon to give a confident diagnosis without a knowledge of their course. Examples of this fact might be drawn from every part of surgery; perhaps one of the best is the one which long prevailed with respect to cases of partial displacement of the head of the humerus with adhesion of the remains of the long head of biceps to the bicipital groove. These cases are now known to be due almost, if not quite, always to chronic rheumatic arthritis, and not to rupture of the long tendon of the biceps from injury; the diagnosis having been established mainly by the course of the disease (Vol. I., p. 118).

Effects of treatment.—When the nature and effect of previous treatment can be accurately ascertained, a great auxiliary to diagnosis is often acquired; in fact, in many cases the diagnosis can hardly be established without some such auxiliary. This is particularly the case in tumors of the testis, in which it is often impossible to tell whether the disease is malignant or simple chronic orchitis until the effect of a mercurial course has been noted (Vol. II., p. 935). So in tumors connected with bone. It is often impossible to say whether the swelling be a strumous, syphilitic, or rheumatic node, or a new growth, until the effect of appropriate local and constitutional treatment has been patiently watched. But here especial care must be taken to guard against errors which are very liable to occur if the effect of treatment be judged of from the statements of the patient; so that little importance can be attached to this particular in forming the diagnosis, unless the treatment has been watched by the surgeon himself, or has been noted by another medical observer. Even then the temporary fluctuations occurring in all diseases are a fruitful source of error; as in the instance cited above of a tumor of the testis, in which the diagnosis between cancer and chronic inflammation is to depend on the effects of a mercurial course. In malignant disease, temporary improvement of the patient's condition, and even some apparent diminution of the tumor, often follow on the rest in bed and other measures which are then for the first time adopted; and thus the surgeon is liable to be deceived into the belief that his treatment is acting upon an inflammatory disorder.

II. *Symptoms.*

The second of our general heads is that which comprises the symptoms presented by the patient at the time of examination. These symptoms are either those which the patient describes or those which he exhibits. Here the second of our general heads touches closely on the third; for the examination of the patient's body discloses changes from the healthy condition which are in reality nothing but symptoms. In this place, however, it is intended to describe not the local lesions, but the general alterations from the natural state—the general physiognomy, as it were, of the disease. It is in the application of these general symptoms to the diagnosis of disease that the surgeon has most need of an intimate acquaintance with physiology, since he has to connect all the functional disturbances which he discovers with the appropriate lesions of the organs presiding over those functions, and those again with their possible causes. It is difficult to arrange these symptoms in regular order, as we have done the particulars embraced under the title of "History." Unlike what occurs in medicine, almost every surgical disease has its local seat, and the few diseases which affect the whole body, as struma, constitutional syphilis, multiple or constitutional cancer, and erysipelas, are generally obvious. Thus surgical diagnosis, as far as it deals with the symptoms of disease, is chiefly concerned in obtaining a minute knowledge of the signs of each particular local ailment, and in separating them from each other. When the surgeon has

stance, morbus coxarius in children is almost universally attributed by the mothers of the children to a blow, fall, or sprain, and by their medical attendants to the strumous diathesis, without which it is said that the local violence would have been harmless. Which party is most in the right? It is very difficult to say; yet the point is very important to the diagnosis. If the disease be due to local violence in a child otherwise healthy, its character may be diagnosed as inflammatory, and local treatment may be expected to cure it; and so in the last resort, provided that so severe a measure be necessary, the excision of the whole of the diseased parts may often be expected to succeed; while if the affection be diagnosed as a constitutional one, the surgeon could hope little from local measures. I have selected this instance in order to afford myself an opportunity to put on record my conviction that the diseased joints of children are too often set down hastily as "strumous," when in reality the affection is in no manner connected with the strumous constitutional taint.[1] It is very well known how frequently disease comes on, even after the lapse of a considerable time, in parts which have been the seat of injury (Vol. I., p. 386); but it is extremely difficult to decide whether this is due to a real connection, or is a mere coincidence.[2] But the difficulty of deciding as to the action of an injury is not unfrequently complicated by the doubt whether the injury has really occurred or no. For instance, how very often young female children are said by their parents to have contracted gonorrhœa from illegal intercourse, and how seldom is anything of the sort proved. If every such story was credited by those who see much of infantile leucorrhœa, they would get into constant trouble and disgrace. (See the essay on SURGICAL DISEASES OF CHILDHOOD.) Besides such sources of deception, which rest upon honest mistakes (for the parents usually believe the disease to be so caused), the occasions for wilful deception are numerous. Many surgical diseases and injuries
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[1] Mr. Bryant would repudiate the term "strumous disease" of a joint altogether (Surg. Dis. of Children, p. 123). This may be going a little too far; but the term has no doubt been much abused.

[2] It is well known that Sir B. Brodie's death was caused by malignant disease of the shoulder, and that the same shoulder had been the seat of dislocation some years before; but considering how often shoulders are dislocated, and how rarely any such disease follows, it is very difficult to believe that we have more in this instance than a casual coincidence.

tumor attained considerable dimensions is a point of extreme importance. The sudden formation of hernia, the gradual descent of psoas abscess, the slow growth of hydrocele, the rapid formation but slow increase of hematocele, the steady and rapid growth of malignant tumor of the testis, the slow increase and frequently the complete suspension in growth of varicocele—are among the points connected with this part of the subject which have been dwelt on in the preceding pages.

Yet here again errors may easily be made. Thus some innocent tumors grow more rapidly than some cancers do; and in all tumors we must remember that the growth may have attained a large size before it has been noticed. Sometimes the growth of cancer is suspended during even a very considerable time (Vol. I., p. 282). Again, in the course of a chronic affection, acute inflammation may occur; and the duration of the disease may be greatly influenced by the patient's time of life.

Course of disease.—The course of the disease, from its onset up to the first visit of the patient, is of great importance, when it can be clearly traced; and so to a still greater degree is its course after the patient has come under treatment. There are not a few diseases of which no skill can enable the surgeon to give a confident diagnosis without a knowledge of their course. Examples of this fact might be drawn from every part of surgery; perhaps one of the best is the one which long prevailed with respect to cases of partial displacement of the head of the humerus with adhesion of the remains of the long head of biceps to the bicipital groove. These cases are now known to be due almost, if not quite, always to chronic rheumatic arthritis, and not to rupture of the long tendon of the biceps from injury; the diagnosis having been established mainly by the course of the disease (Vol. I., p. 118).

Effects of treatment.—When the nature and effect of previous treatment can be accurately ascertained, a great auxiliary to diagnosis is often acquired; in fact, in many cases the diagnosis can hardly be established without some such auxiliary. This is particularly the case in tumors of the testis, in which it is often impossible to tell whether the disease is malignant or simple chronic orchitis until the effect of a mercurial course has been noted (Vol. II., p. 935). So in tumors connected with bone. It is often impossible to say whether the swelling be a strumous, syphilitic, or rheumatic node, or a new growth, until the effect of appropriate local and constitutional treatment has been patiently watched. But here especial care must be taken to guard against errors which are very liable to occur if the effect of treatment be judged of from the statements of the patient; so that little importance can be attached to this particular in forming the diagnosis, unless the treatment has been watched by the surgeon himself, or has been noted by another medical observer. Even then the temporary fluctuations occurring in all diseases are a fruitful source of error; as in the instance cited above of a tumor of the testis, in which the diagnosis between cancer and chronic inflammation is to depend on the effects of a mercurial course. In malignant disease, temporary improvement of the patient's condition, and even some apparent diminution of the tumor, often follow on the rest in bed and other measures which are then for the first time adopted; and thus the surgeon is liable to be deceived into the belief that his treatment is acting upon an inflammatory disorder.

II. *Symptoms.*

The second of our general heads is that which comprises the symptoms presented by the patient at the time of examination. These symptoms are either those which the patient describes or those which he exhibits. Here the second of our general heads touches closely on the third; for the examination of the patient's body discloses changes from the healthy condition which are in reality nothing but symptoms. In this place, however, it is intended to describe not the local lesions, but the general alterations from the natural state—the general physiognomy, as it were, of the disease. It is in the application of these general symptoms to the diagnosis of disease that the surgeon has most need of an intimate acquaintance with physiology, since he has to connect all the functional disturbances which he discovers with the appropriate lesions of the organs presiding over those functions, and those again with their possible causes. It is difficult to arrange these symptoms in regular order, as we have done the particulars embraced under the title of "History." Unlike what occurs in medicine, almost every surgical disease has its local seat, and the few diseases which affect the whole body, as struma, constitutional syphilis, multiple or constitutional cancer, and erysipelas, are generally obvious. Thus surgical diagnosis, as far as it deals with the symptoms of disease, is chiefly concerned in obtaining a minute knowledge of the signs of each particular local ailment, and in separating them from each other. When the surgeon has thus become accustomed to connect each disease with its own group of symptoms, he has to compare each group in his own mind with the account which the patient has given of his sufferings from the disease under examination. Here the difficulty is twofold. In the first place, as regards the group of symptoms which we have been taught to associate with the name of each disease. These groups have been laid down in our books, as is done in the previous part of this work, with all the conscientious exactness which the subject demands. But we must remember that the names of diseases frequently do not represent natural objects created different from each other; but are merely designations which have been affixed to sets of symptoms grouped together by nosologists. Now the infinite variety of nature easily eludes the bounds of our formal classification; and we are constantly meeting with groups of symptoms which can only be brought under one of these designations instead of another by a certain amount of violence, and which do in fact partake of the nature of both. Thus, to take an instance lying at the very threshold of our pathology—ulceration and gangrene in soft parts, or their equivalents caries and necrosis in bone, are names given to what are really parts of the same process, viz., the termination of inflammation in local death. The things are easy enough to distinguish from each other in extreme cases. When the bodies of several vertebræ have, as it were, melted away, without any visible portion of dead bone having ever been known to have exfoliated, there can be no hesitation in saying that here we have caries, not necrosis; when a limb drops off from the trunk black and rotten a few days after an injury, that this is gangrene, not ulceration. But in many cases the two processes are mixed; and may receive different names from equally competent observers. Persons not in the medical profession, with whom the names of diseases are naturally held to represent real entities, are of course scandalized at such differences, and believe that they show either ignorance in the persons or imperfection in the art. They really show nothing except that scientific language cannot acquire the copiousness and variety of the natural processes. This difficulty, however, though it may lead to some confusion and some apparent difference of opinion in the intercourse of practitioners with each other, is not otherwise of much practical moment, since the indications of treatment depend less on accuracy in naming the disease than on sagacity in weighing its chief symptoms. The second is the more important of the two difficulties, viz., the difficulty in ascertaining from the patient what the symptoms really are. Patients who have acquired, as so very many have, a superficial knowledge of medical books, can easily describe the leading symptoms of cancer, uterine disease, stone, etc., which they either feel or imagine they feel. Besides, without the exercise of unusual caution it is very difficult for the surgeon to avoid putting leading questions on a hypothesis hastily formed; and such questions are pretty sure to be answered in the way he desires. Thus great caution in weighing the patient's assertions, and comparing them with the indications to be drawn from his general condition and from the local appearances, is required in one who is to be a good investigator of symptoms; and with this should be conjoined much deliberation in forming any guess at the diagnosis before the evidence is complete, and much dexterity so to phrase the questions addressed to the patient as not to suggest to him in what way to answer them.

The least unsatisfactory way of arranging the symptoms appears to be in the order of the various organs whose functions such symptoms show to be disturbed. The table printed below (p. 917) will prove one of the most convenient methods of arrangement; and we shall devote in the sequel a few lines of some illustrations of the groups of symptoms which are comprised in each of its headings, and of their practical importance in surgical diagnosis.

Nervous system.—The first class of symptoms are those referred to the nervous system—the brain, spinal cord, and nerves. In our table these several parts of the nervous system have been separated from each other; and it is one of the main objects of the diagnostician to effect this separation; that is to say, to determine what symptoms point to the brain, what to the spinal cord, what to the nerves. To illustrate from one of the most common surgical symptoms, loss of motion following on injury. If the loss of motion affects one side of the body only, and is complicated with loss of consciousness, it is a clear indication of limited pressure of the brain. If no loss of consciousness is observed, it is only after the most searching investigation that we can admit that the loss of motion depends on lesion on the brain; yet if the palsy is strictly limited to one side of the body or to one set of nerves, this is the more likely hypothesis. If it affects both sides of the body, but not the intellect, or the facial muscles, or the functions of the nerves of special senses, the lesion must be in the spinal cord, at a level determined by the origin of the nerves of the highest part to which the palsy extends. And we may observe that the more complete the palsy both of motion and sensation, the more extensive must be the pressure on, or disorganization of, the cord. If, on the contrary, paralysis of the whole body is present with coma, the lesion must affect the brain, and that to a very great extent. If the loss of motion affects only a small part of the body, as a single limb, or a segment of a limb, or a still smaller part, it is clear that the nervous centres themselves are untouched; the lesion has either implicated one or more of the nerves; or else the loss of motion depends on injury to bones, joints, or muscles. The diagnosis depends in a great measure on whether the extent of the paralysis does or does not coincide with the anatomical distribution of the nerves.

Pain.—In the table already referred to, pain, which is of all symptoms the most universal, has been placed under the head of "nerves;" but this is only an arrangement dictated by convenience. The sense of pain, though always conveyed by the nerves, yet, as a diagnostic indication, comparatively very seldom points to the nervous system itself, but is usually indicative of a morbid state of the organs from which the nerves are derived. Want of space alone is a sufficient obstacle to our discussing the wide question of the value of pain as a symptom of disease.[1] Study of any section in the previous part of this work will show that almost every single affection has its peculiar kind and degree of pain. Such a study will also prove how much caution is required in estimating this complex and universal symptom; how easily inflammatory pain may be confounded with neuralgic or hysterical, and *vice versâ*. Again, the affections of many organs are signalized by pain in remote parts; as the pain in the knee, which is symptomatic of disease of the hip; the pain in the meatus urethræ, symptomatic of stone or ulceration of the bladder, or sometimes of disease of the kidneys; and generally the great number of instances in which pain referred to the extremity of a nerve is symptomatic of irritation at a higher part of its course.

Organs of sense.—The symptoms referred to the organs of sense are those defects of sight, taste, smell, hearing, and touch, which are almost always present in all diseases, and which point either to organic lesions, functional disturbances, or affections of the nervous system, as the case may be. It would be endless to enumerate them. Let us take a prominent instance. If the student will turn to the essay on DISEASES OF THE EYE (Vol II., p. 101), he will find an account of the numerous organic lesions of the deeper parts of the eye upon which loss of sight may depend; but loss of sight, even total loss, may be symptomatic merely of some affection of parts remote from the eye, as abscess of the antrum (Vol. II., p. 569); or may depend on some disease of the brain or the optic nerve (Vol. II., p 100); or may be merely an effect of hemorrhage, or of some depressing habit producing anæmia of the choroid or retina (Vol. II., pp. 103, 104). Most of these symptoms are obviously local, and their interpretation depends in a great measure upon the results of a physical examination of the organ.

Organs of respiration.—The symptoms referred to the respiratory organs, though of less vital importance in surgical than in medical diagnosis, are yet numerous and highly important. We must be content here with one or two illustrations of the truth, that the broad facts, at any rate, if not the minutest phenomena, in this group of symptoms must be as present to the mind of the surgeon, if he would succeed in diagnosis, as to that of the physician; and it must not be forgotten that the diagnosis of surgical affections of the respiratory organs involves often that prompt action on which the instant saving or loss of life depends. Thus, in injuries of the neck, the importance of recognizing the dyspnœa which may arise from fracture with displacement of the hyoid bone, and distinguishing it from the numerous other causes which may produce the same effect, is well illustrated by the case related at p. 112. Again, in the same class of cases, it is of the utmost importance to have studied minutely the symptoms produced by the impaction of a foreign body; to distinguish, for example, between the usually paroxysmal dyspnœa, with pain about the thyroid cartilage, but without fever or effusion in the air passages, which are the leading symptoms of a foreign body impacted near the glottis, and the dyspnœa of croup (Vol. I., p. 708). It is true that the history, if it could be relied on, would make the diagnosis certain; but frequently in these cases the history is unknown or fallacious. To proceed with the same illustration, the reader may consult (Vol. I., p. 706) what has been said about the diagnosis between pneumonic consolidation causing absence of respiratory murmur, and the same phenomenon as the consequence of impaction of a foreign body in one of the main bronchial tubes. So too of the diagnosis between the various sources and kinds of effusion into the pleura after accident (Vol. II., p. 769 et seq.).

Organs of circulation.—The condition of the organs of circulation is of very great importance in surgical diagnosis; not merely the general state of the pulse, which is always noted as a matter of course in all diseases, medical and surgical, but also the irregularities in the organs of local circulation, arterial, venous, and lymphatic. The various alterations in the arterial circulation caused by an aneurism furnish the most familiar example of the diagnostic signs drawn from the arteries; but there are innumerable others; among which we may instance the sudden loss of pulse in the lower part of a limb, traceable up to a definite point, after an injury, without great ecchymosis, diagnostic of rupture of the inner coats of an artery (Vol. I., p. 462); the extraordinary enlargement of arteries naturally imperceptible, which is observed in aneurism by anastomosis (Vol. II., p. 392); and the peculiar thrill noticed in the pulsation of the larger arteries in anæmic persons. In the venous circulation, some of the most common diagnostic phenomena are the passive enlargement of the veins of a part, with or without œdema, which marks simple obstruction at a higher point of the vessel, whether from coagulation of the blood, or pressure of a tumor; the hardness, redness, and tenderness along the vein, with œdema, which characterize phlebitis (Vol. II., p. 293); the purring thrill which is felt in large veins from pressure not completely interrupting the current. In the absorbent system, besides the direct evidences of inflammation (Vol. II., p. 487), and the rare examples of lymphatic fistulæ (Vol. II., p. 473), the chief phenomena to which attention is called in diagnosis are those of simple inflammatory or specific enlargement of the glands.

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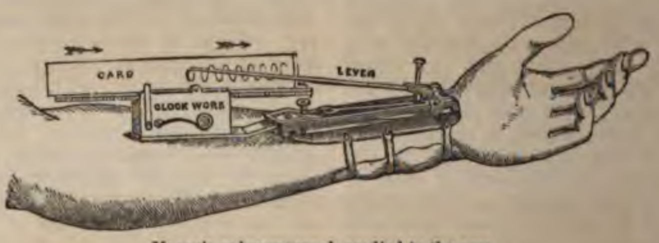
[1] The reader may be referred to Mr. Hilton's Lectures on Rest and Pain.

The errors which may be committed in the interpretation of these symptoms are very numerous. Thus the sudden stoppage of the arterial circulation may be due to embolism and not to accident; the enlarged vessels around a vascular tumor, though they pulsate, may be some of them veins;[1] the thrill referred to anæmia may be due to aneurism; the venous enlargement and œdema may be due to simple retardation of the circulation without positive obstruction; the glandular enlargement to irritation, and not to morbid deposit.

[It may not be amiss to refer to the sphygmograph, as a valuable instrument in the study and diagnosis of diseases affecting the circulation. The subject is too extensive to be entered upon at length here, especially as it is not yet fully developed. But the reader who may desire to look further into it, will find much valuable information in Dalton's Treatise on Human Physiology, 7th ed., p. 289; also in Flint's Practice of Medicine, 5th ed., p. 101, and in Hartshorne's Essentials of Practical Medicine, 5th ed., p. 124. Marey's sphygmograph is shown in fig. 970. "It consists essentially of a very delicately adjusted lever, one end of which rests upon an upright, which by a rounded surface, presses on the radial artery at the wrist; while its free end sustains a pen, whose point is placed in contact with a strip of paper, kept in steady motion by clockwork. Each beat of the pulse, therefore, magnified by the lever, is registered in a waving line upon the paper. Some observers prefer a smooth point acting upon smoked glass for the registration" (Hartshorne). Dr. F. A. Mahomed, of London, has given much attention to this subject, and has described a modification of Marey's instrument (Med. Times and Gazette, Jan. 20, 1872). Another form of sphygmograph, known as Pond's, has met with much favor in this country (fig. 971). Fig. 972 represents the tracing from the pulse of a person in vigorous health, fig. 973 that of the right radial pulse in a case of thoracic aneurism, and fig. 974 that of the left in the same patient.]

Fig. 970.



Marey's sphygmograph applied to the arm.

Digestive systems.—Besides the general indications which are to be drawn from the condition of the tongue and of the bowels, the symptoms which refer to the various portions of the alimentary canal occupy a high place in the diagnosis of many surgical ailments. The importance of studying the general condition in cases of constipation, in order to the diagnosis between mere mechanical obstruction, acute strangulation, inflammation, and simple inaction, will be appreciated by perusing the observations on that subject (Vol. II., p. 599 et seq.). Perhaps we ought also to illustrate the fact, that symptoms referable at first sight to the digestive system may be only reflex phenomena excited by disease or injury of remote parts. The familiar instances are the vomiting, which is symptomatic of early disease of the kidneys, and that which almost always follows on superficial injuries of the brain (Vol. I., p. 642).

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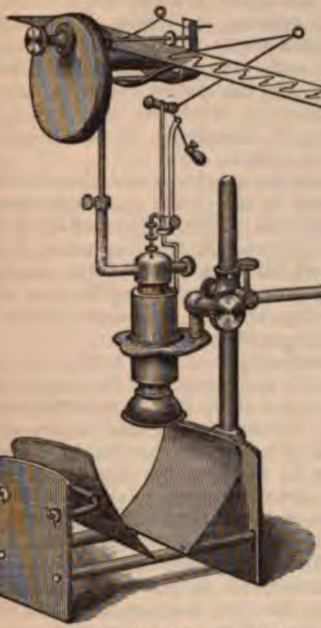
[1] This has been particularly noted in arterio-venous aneurism, as in Mr. Moore's case, quoted at Vol. II., p. 389; but I have seen the same thing in cirsoid aneurism.

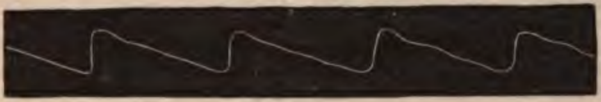
[Fig. 971.



Pond's sphygmograph.]

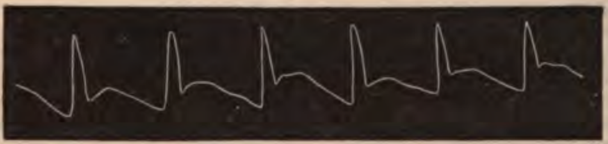
Urinary organs. — The general symptoms which are referred to the urinary organs are less important in surgery than in medicine, these symptoms being mainly confined to the cases of local disease of the organs, but not entirely so. A perusal of the essay on DISEASES OF THE URINARY ORGANS will show how numerous and complicated are the general phenomena which the surgeon must master in order to the successful diagnosis of the affections of that system. With reference to the bearing of urinary phenomena on the general condition of the patient, the most practical example is the frequent disappointment which operating surgeons experience from having neglected to examine the urine before proceeding to operation, and having accidentally performed a serious but avoidable operation on a patient laboring under Bright's disease. It ought to be a fixed rule never to operate on a case of chronic disease of a joint, to extirpate a large tumor, or perform

[Fig. 972.



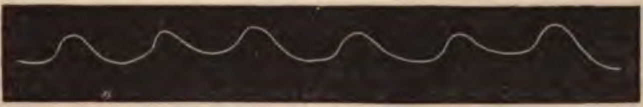
Firm and long pulse of vigorous health.

Fig. 973.



Right radial pulse in a case of thoracic aneurism (Finlayson).

Fig. 974.



Left radial pulse in same (Finlayson).]

any other operation which is not absolutely inevitable, without a previous careful examination of the urine.

Genital organs.—The functions of the genital organs are disturbed almost exclusively by local diseases; but in the male sex a few general diseases react on the sexual system; an example of which is the atrophy of the testicles which follows mumps in some rare cases (Vol. II., p. 915), and occasionally succeeds injuries of the head (Vol. II., p. 946). In the diagnosis also of some affections of the brain, it is important to note the sexual symptoms; an instance of which is furnished by the perverted sexual appetites which are occasionally symptomatic of epilepsy, and are sometimes regarded as its exciting cause (Vol. II., p. 942).

Locomotive system.—The locomotive system also furnishes us chiefly with indications comprised under the head of "Physical Examination," unless the skin be included under this term. Every symptom connected with this great eliminant organ should be most carefully noted in the first and in all subsequent examinations of the patient. Its heat, dryness, harshness, color, state of circulation, presence of eruptions, and a host of other particulars too numerous to mention, furnish diagnostic indications of the greatest importance.

Micellaneous.—Finally, there are some miscellaneous symptoms which cannot be referred to any of the organs of the body, but which may have a considerable influence on the diagnosis of the disease.[1] Thus the condition of restlessness and malaise which accompanies inflammatory fever (Vol. I., p. 77); the cachexia which is so striking in some cases of cancer (Vol. I., p. 301); the general physiognomy which is to a certain extent characteristic respectively of hysteria (Vol. I., p. 587), of struma (Vol. I., p. 166), and of secondary or constitutional syphilis (Vol. I., p. 213); the tendency to symmetrical occurrence in certain diseases (*e.g.*, hypertrophy of the bones of the face, Vol. I., p. 267), are particulars not to be referred to any distinct system of organs, but which it would be extremely inaccurate to overlook in forming a diagnosis.

III. *Physical Examination.*

Our third elementary division refers to the physical examination of the diseased parts. As this must of course be done by the surgeon's senses, it is convenient to refer to the main particulars under the head of the special sense by which they are perceived: as those which are discovered by the sight—alterations in form, in color, in volume, in shape, in transparency, and here we must speak of microscopical and other instrumental observations; by the touch—alterations in consistence, in relation, in volume, in pulsation, in mobility; by the hearing; and by the smell.

To these we ought to add chemical examination, in which all the above senses are employed. This method of examination has superseded the disgusting applications which were made of the sense of taste by the medical practitioners of a former day, so that this sense bears no part in diagnosis.

The microscope.—Let us commence this long list of particulars by the visual phenomena; and first of the artificial aids to vision. There are a great many cases in which the surgeon has to make use of the lens in forming his diagnosis. For persons of not very sharp sight, a convex lens is necessary in examining the eye for minute foreign bodies, colorless hairs, crab lice, and on other such occasions; and its aid is invaluable in throwing an oblique light into the eye, to examine the capsule of the lens and the contents of the posterior chamber. In skin-diseases also a lens is very frequently serviceable.

The use of the microscope in surgical diagnosis is a matter on which practical men differ extremely. Like most other things, in this age of minute research, the microscope has become a specialty in practice, and is therefore decried by those who know little of its use, and exaggerated in importance by those who know little else. But the truth lies, in all these cases, between the extremes. What was at one time believed to be the special province of the microscope in surgical diagnosis, viz., to distinguish between cancer and innocent tumors, has been found to be a problem beyond the unaided powers of the microscope; and, in fact, as our knowledge of the subject has advanced, the sharp line which was formerly thought to separate malignant and innocent tumors has become less distinct, and it is generally allowed that there are forms of disease which partake of the character of both (Vol. I., pp. 274, 280); yet the value of a good microscopical examination of a tumor has been fully established, though it is now considered as, in many cases, only one of numerous diagnostic signs, to be used along with the history, the naked eye characters, and the relations of the tumor, in forming a judgment as to its nature; and in that connection of very great importance, although not to be trusted to alone in complicated cases. There are numerous simpler cases of tumor in which microscopical examination alone suffices for diagnosis; but in many of these cases the diagnosis can also be formed without its aid. All this refers to tumors after their removal from the body; but in the living body also it is often possible to remove a very small portion of the tumor by microscopical examination; and such a method is occasionally made use of (Vol. III., p. 386, note).

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[1] A few of these miscellaneous particulars would, in our scheme (pp. 917, 918), be referred to under the head of "Remarks;" the greater number would find a place under the heading "Aspect."

It is, however, in the examination of the fluids of the body, and of substances discharged or said to be discharged, that the microscope has its most undoubted and most important use. The pathology of urinary affections rests almost as much upon microscopical indications as upon all other methods of examination put together. The presence of pus-globules, of blood-globules, of epithelium, of animalcules, of fungi, and of other microscopical objects too numerous to mention, in matters evacuated naturally or artificially, often materially assists or even alone establishes the diagnosis of a case; while innumerable instances of delusion and trickery, in which foreign substances are alleged to have been passed from the mouth, urethra, vagina, and rectum, can only be distinguished from those which are real by its agency; and in the latter case the microscope alone can establish the diagnosis, and thereby perhaps relieve the patient from the fear of an internal tumor, who may have simply passed a shred of undigested meat from his bowels; or announce to one in whom an intussuscepted portion of intestine has been passed the possibility of recovery of health; or again warn the friends of another in whom organized and apparently malignant structures may be passed from the anus, that these are probably the fragments of some hidden tumor in the bowel; or in whom small fragments of feces may be detected in the urine, that these prove the existence of a communication between the bowels and bladder (Vol. II., p. 762).

In skin-diseases again the microscope is indispensable, and has doubtless rendered to that department of pathology the best service which it has received of late, by clearly marking out certain diseases as local, depending on the presence of a parasitic plant or animal, and therefore in all cases curable by simple local measures directed to the destruction of the parasite (Vol. III., p. 795 *et seq*).

The above is not meant as an exhaustive enumeration of the uses of the microscope in surgical diagnosis, but merely as a specimen of its chief applications; and it justifies us in saying, that though a man may be a very good surgeon without being anything of a microscopist, yet the highest attainments in diagnosis cannot be within the reach of such a one.

Ophthalmoscope, etc.—Of the diagnostic value of the inventions for examining special organs it is needless to say anything here, since a reference to the essay on DISEASES OF THE EYE will suffice for the ophthalmoscope; to DISEASES OF THE EAR, for the speculum auris and otoscope; and so on. One word may perhaps be added with respect to one of these instruments, the use of which has excited much contention—the speculum vaginæ. Although there can be no doubt that the examination of women, and especially unmarried women, by this means, has been carried to a most unnecessary, indecent, and reprehensible extent, both in this country and elsewhere, its use cannot on that account be dispensed with in appropriate cases. Those which fall under the care of obstetric physicians need not be spoken of here. The main uses of the speculum vaginæ in surgery are to examine the vagina and neck of the uterus for sores, in case of discharge after suspicious intercourse, to examine and expose tumors situated about the os uteri or in the wall of the vagina, and in plastic operations on the vagina.

Alterations in form.—The surgeon ought to be so intimately acquainted with the natural form of every part of the body, that any variation, beyond those natural minute differences which constitute individuality, should arrest his attention at once. Striking instances of the importance of recognizing any little alteration in form due to disease may be found in every part of surgery. Thus the slight fulness caused by a strangulated obturator hernia was noticed by Mr. Obré as constituting a difference between the two femoral fossæ, and led him to the happy idea of cutting down upon and liberating the constricted knuckle of intestine (Vol. II., p. 738).

Color.—The natural color of parts is composed of the color of the blood circulating in them, and that of any special pigment they may contain, seen through varying thicknesses of skin or through mucous membrane. Hence variations from the natural hue may be caused by alterations in the mass of blood (pallor and redness), or from detention of blood in the part (lividity and ecchymosis), or from absence or undue deposit of pigment (of the former of which albinism may be taken as an example, of the latter melanosis, the cutaneous maculæ, Addison's disease), or from undue thickening of the cuticle, or cutification of the mucous membrane (as in prolapsus vaginæ).

Volume.—The alterations in the volume of parts depend either on hypertrophy of their natural elements, or on fluid or air effused into their interstices, or on the organization of inflammatory products, or on the pressure of a new formation. In distinguishing these various particulars from each other, the touch must often come to the assistance of the sight. The hypertrophy of the skin and cellular tissue which constitutes elephantiasis can indeed be recognized by the unaided sight; but in order to distinguish between the thickening of hypertrophy (so called) of bone, and that of periosteal deposit, the part must be carefully examined with the hand; so of the swelling of œdema or emphysema, of dropsical effusions, of chronic inflammation, and of tumors.

Transparency.—The familiar instance in which transparency is used as the test of the nature of a disease is hydrocele; but in a few other cases it is also employed, as in cysts in the popliteal space, occasionally. Opacity also is a phenomenon which is still more frequently noted by the surgeon, and more especially in the humors of the eye.

Consistence.—Alterations in consistence are, amongst all other tactile indications, those from which diagnosis derives most frequent assistance. It would be endless to enumerate all of them; the softening or hardening of different stages or varieties of inflammation, the flabbiness of atrophy, the rounded softness of fat, the boggy feeling of gangrene—are among the most familiar illustrations. Some among these tactile phenomena, however, deserve special mention, viz., emphysema, crepitus, and fluctuation. The first is the peculiar crackling which denotes the presence of air in the cellular tissue. It is a sensation which is often to be met with, and which, when once known, can hardly afterwards fail to be recognized, since there is nothing else exactly like it. It is a kind of crepitus, but cannot be confounded with that sensation. Its most common cause is the escape of air from the respiratory organs into the cellular tissue; and it becomes a sign of importance in wounds or contusions of the neck and injuries of the chest, proving the existence of a wound of the trachea, a fracture or rupture of the larynx or some lower part of the tube, an injury of the lung in cases of fractured ribs, an opening of the pleura or a wound of the lung in penetrating wounds of the chest. But there are many other causes of emphysema. It occurs, though rarely and only to a limited extent, around punctured wounds in any part of the body, or around the opening of an abscess; it may be caused by a wound of any part of the gastro-intestinal tract,[1] and is one of the symptoms of the decomposition of the tissues in gangrene.

Crepitus is a name given by surgeons to the crackling produced by the rubbing of two rough surfaces together. When used in a surgical description without any qualifying adjective, it is intended to signify the rough grating which is produced by the friction of two exposed bony surfaces on each other. It is, therefore, pathognomonic of fracture in a case of recent injury, and of erosion of the cartilages and ulceration of the exposed bony surfaces in a case of joint-disease. There is no sensation which can be confounded with this kind of crepitus, nor any ambiguity in the indications to be drawn from it. But besides this fresh rough bony crepitus there are other kinds of crepitus, indicating different conditions, and sometimes rather difficult to make out. The effusion which follows inflammation of the sheath of a tendon produces a kind of crepitus which, in its simplest form, is very easy to distinguish from bony crepitus, it being more of a creaking than a crackling, and obviously produced by the rubbing of soft though somewhat rough surfaces together (Vol. III., p. 391). As the lymph which produces the sensation becomes drier and harder, the crepitus becomes rougher, but never attains the crisp decided feeling of the crepitus of a recent fracture. But the crepitus of a fracture becomes less crisp and decided as the bony ends get rounded off and coated with soft matter. Hence in injuries which are not recent, it is often difficult, and sometimes impossible, to decide whether the crepitus is from effusion in sheaths of tendons or in joints, or whether it is from fracture. This is particularly the case in the examination of injuries of the shoulder-joint some time after their infliction.

Again, crepitus is produced in old rheumatic disease of the joints; but it is usually easy to distinguish this from the crepitus of caries; for this crepitus, being due to the rubbing of the "additamentary" pieces of bone on each other, is far freer and more decided, and is obviously caused by portions of bone far more movable than the carious surfaces of a joint can be. I have seen a case in which the sound produced was so loud that it could be distinctly heard at some distance (Vol. III., p. 256).

The most important of all the diagnostic signs dependent on the touch is *fluctuation*, or the sensation of fluid enclosed in a cavity. This sensation depends on the well-known properties of a fluid, viz., that its particles are movable on each other by the slightest possible force, or, in other words, that a fluid has no cohesion, and that it is incompressible. The most perfect example of this sensation is where thin serum is enclosed in a moderately tense bag, as in the case of a large ascites. In such a case, if a finger be firmly laid upon any part of the bag, the least tap given to any other part of the bag with the fingers of the other hand will cause a distinct wave of fluid to strike the first finger. This is the most usual way of ascertaining fluctuation, and the most certain; but of course it is not available for limited and deep-seated collections. Smaller collections are more usually tested in this manner: alternate pressure is made with the fingers of the two hands; when one finger is pressed down gradually and firmly on the collection of fluid, the latter, being incompressible, transmits the pressure, however slight it may have been, to the other finger; and the sensation of a rounded elastic body is communicated to that finger. This sensation is usually verified by repeating the proceeding with the two hands alternately. Care must be taken not to forget that the elastic reaction of the fluid is perceived, not by the finger which is making active pressure on the tumor, but by that which is lying still on its surface, and therefore to direct the attention to that finger. The perfection of the sensation depends on the fluid being enclosed in a capsule, and on its not being too deep-seated. When the quantity of fluid is small and deep, another method is often used. This consists in pressing the end of the finger sharply down upon the supposed fluid and suddenly withdrawing it a little, when the wave of fluid which was driven down by the push of the finger will rise up and strike against it.

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[1] After a wound of the rectum made in puncture of the bladder per rectum, I have seen emphysema occur and extend up to the chest; so that the feeling of the parietes of the thorax was just what is perceived in cases of fractured ribs.

It is in his accurate perception of fluctuation that the surgeon chiefly shows his tactile accomplishment. But there are many cases in which it is very difficult to decide upon the presence of fluctuation, and many in which it is impossible. Nor need this appear strange if the cause of the sensation be considered. It depends mainly on the fact that the particles of a fluid are movable on each other by the slightest possible force; that it has no cohesion. But this, though true of the pure fluid with which physical reasoning is conversant, as the pure serum in the above instance, is by no means true of the mixed substances sometimes found in the body, of which it is difficult to say whether they are more fluid or solid, and which are very soft and very elastic, but still can hardly be said to have no cohesion or to be incompressible. Thus in some very soft tumors, almost of creamy consistence, such as the most rapidly-growing of the cancerous tumors of the liver, it is impossible, even after they have been removed from the body, to say whether they fluctuate or not; and in the soft mass of granulations into which the synovial membrane of the knee is converted in the gelatiniform degeneration, it is hardly possible to say whether the soft mass does or does not contain one of those limited collections of fluid, so often found there, without the use of the grooved needle.

The latter instrument should always be used in such cases, and will clear up any doubt which the surgeon may feel.

Fluctuation may always be prevented by the thickness of the sac in which the fluid is contained, as in some old hydroceles; or by the extreme tension of the sac preventing the slight displacements which are essential to the undulation of the fluid. This, also, is often noticed in hydrocele. The extreme depth of the collection, again, and the mass of soft parts covering it, may so obscure the sensation as to prevent any confident diagnosis. In order, therefore, to avoid errors as far as possible, and to avoid the appearance of error in circumstances where an accurate diagnosis has been unattainable, the surgeon must be very careful to familiarize himself with the numerous circumstances in which fluid may be present without fluctuation being felt, and, on the other hand, where a deceptive sensation of fluctuation may be elicited from soft and elastic solids. [For example, if pressure be made with either hand alternately *across* a mass of muscle, not tense (any one can try it upon his own thigh), the feeling is precisely that of a collection of fluid. But if the hands are placed *lengthwise* with the muscular fibres, no such sensation is communicated. It must be obvious that ignorance of this fact might betray the surgeon into mortifying error.]

Relation.—Changes in the natural relations of parts are appreciated chiefly by the touch, though this is often assisted by sight, and occasionally by hearing. They chiefly refer to those alterations in the position of prominent points of bone, which are produced either by violence in fracture or dislocation, or by muscular action in diseases of joints, and in some affections of bone. In the exploration of the abdomen for tumor or to diagnose the seat of obstruction, and in exploration of the chest with reference to the diagnosis of fluid in the pleura, the ear also comes into play. Beside the actual changes in position, changes in the direction of bones become sometimes of much consequence, as in the diagnosis of dislocations of the shoulder. In some chronic diseases also the relations of parts undergo changes which it is of the utmost importance to anticipate and discover. A notable instance of this is the displacement which the femoral artery sometimes suffers in chronic abscess of the thigh, where the vessel has been wounded by the very care which has been taken to make the incision away from its normal course.

Mobility.—Alterations in mobility depend on the solutions of continuity of bones, ligaments, or fasciæ, on the one hand, whereby parts which ought to be fixed become movable; or, on the other, on chronic inflammation, leading to adhesion or ankylosis, by which movable parts become fixed. The most common illustration of unnatural mobility is that of fracture; and perhaps the most perfect instance of the diagnostic value of loss of natural mobility is in early disease of the hip. When other symptoms might be doubtful, the contrast in mobility of the sound and diseased joint will usually at once clear up the case.

Pulsation.—The alterations in pulsation have been already spoken of, under the symptoms referable to the organs of circulation. Every opportunity should be taken of studying the various kinds of unnatural pulsation which are noticed in diseased vessels, and of verifying by post-mortem examination the morbid conditions on which they depend; such as the expansive pulsation of ordinary aneurism, the obscure thrill of extravasation depending on ruptured artery, the vibrating and purring thrill of arterio-venous aneurism, the tremulous movement often perceived in the large arteries (chiefly the abdominal aorta) in anæmia.

Sound.—The faculty of hearing is to be employed in many parts of surgical diagnosis, although it may be less important than in medical diagnosis. The use of the stethoscope ought never to be neglected; and every opportunity should be taken for becoming familiar with the healthy and morbid sounds, and for tracing upon the dead body the causes upon which the latter depend. The great importance of the bruit in the diagnosis of aneurism is the most striking instance of the employment of the ear in surgery; but it must not be forgotten that aneurisms exist without bruit—in fact the most numerous class of aneurisms, the thoracic, are very frequently devoid of all sound—and that also (but much more rarely) bruit exists without aneurism, as in a few cases of pulsatile malignant tumor (Vol. II., p. 340), or of tumors pressing on large arteries (Ibid., p. 338). In cases of suspected stone, the ear gives the most definite and unmistakable evidence of the presence of the foreign body. In necrosis the ring of the probe against the hard exposed bone is very characteristic. In cases of injury to the thorax auscultation becomes occasionally indispensable; and in a few other circumstances the sense of hearing furnishes useful data.

Smell.—The province of this sense in diagnosis is very limited, since, though peculiar odors are associated with many morbid conditions, their other symptoms are quite sufficient to distinguish them, or if not, the diagnosis could not be established by the odor. Perhaps favus may be an exception, in which the peculiar mouse-like smell is considered as a characteristic of great value. Some surgeons attribute much importance to the smell of matter discharged from a sinus, as indicating, by a peculiar sanious odor, that it proceeds from a carious surface of bone; but too much stress should not be laid on this.

Chemical examination.—The province of chemistry in establishing the diagnosis of surgical ailments is not very extensive, although in confirming that diagnosis, and in suggesting a rational plan of treatment, it is frequently useful. In urinary diseases, indeed, some chemical examination of the secretion is necessary; and the same may be said in cases of stone: but there are few other instances in which chemical analysis is necessary in the ordinary exigencies of surgery. In medical jurisprudence, however, chemical examination is indispensable in almost every case.

Such are the chief sources of surgical diagnosis; and in order not to overlook any of them in examining the cases which come before him, it is useful for the student at the commencement of his practice to be prepared with a form which may embrace them all, and suggest them to the examiner. Such forms are still more useful in the registration of hospital cases, where reference is so much facilitated by uniformity of system. Accordingly, I have subjoined a form for the registration of cases, which was devised by Dr. Bristowe, to whose kindness I am indebted for its insertion. It has been in use for some years at St. Thomas's Hospital, and is adapted to both medical and surgical cases. An example of a case of either kind is inserted on the form. These forms are intended also to serve as indexes to the detailed notes of the most important cases, which would of course be taken at considerable length, and numbered. These detailed notes are to be marked with the same number as is prefixed to the column appropriated to the tabulated case. Thus a reference to the symptoms connected with any of the main headings in the table would at once give all the morbid phenomena connected during life with each organ or system of organs. The post-mortem register is to be arranged on the same plan, and a second reference to it would give all the morbid appearances with which these phenomena are associated. Thus, if the lines are traced horizontally, they give a succinct account of the morbid conditions of the various organs, and references to a more accurate and detailed account of those conditions when necessary; while, if the columns be read vertically, they give a succinct account of the symptoms connected with each particular disease, and (as before) a reference to a more copious account when necessary.

TABLE FOR REGISTRATION OF MEDICAL AND SURGICAL CASES.

	1. Disease for which admitted. Duration.	1st attack. 1. Acute rheumatism. 3 weeks.	Acute necrosis of femur. 12 hours.
	2. Associated disease. Duration.	2. Mitral-valve disease.	Pyæmia.
	3. Result.	(1) Cured. (2) Nil.	Dead.
	4. Sex. Age. Occupation.	F. 16. S. Servant.	M. 5½. Child.
	5. Date of Admission. Date of Discharge. No. of days in Hospital.	Dec. 9. Jan. 24. 46 days.	March 29. April 9. 11 days.
NERVOUS SYSTEM.	Brain.	Want of sleep at times from pain.	No sleep last 6 or 7 days: sensible to last.
	Spinal cord.		×
	Nerves.	Pain in many joints (shifting); pain in chest.	Severe pain in right thigh, and left side of face; and for short time in left wrist.
	Organs of sense.	×	×
ORGANS OF RESPIRATION.	Larynx and trachea.	×	×
	Lungs.	Slight cough on admission.	Severe incessant loose cough last 3 days with short breath. Chest resonant.
	Pleuræ.	×	
	Expectoration.	×	None.
ORGANS OF CIRCULATION.	Heart.	Increased area of dulness (? effusion). No friction. Systc. m. at apex 11 d. after admission, persistent.	—
	Pericardium.		—
	Arteries.	P. regular; quick.	P. about 160. Imperceptible last day.
	Veins and capillaries.		
	Blood.		
	Lymphatic system.		
ORGANS OF DIGESTION.	Tongue, mouth, and salivary glands.	T. furred on admission and for some time after.	T. moist, but furred. Last 2 or 3 days dry.
	Fauces, pharynx, and œsophagus.		Abscess on L. side in neighborhood of fauces; opened day before death.
	Peritoneum.		×

TABLE—*continued.*

ORGANS OF DIGESTION.	Liver.		No jaundice.
	Spleen, thymus, thyroid, and S. R. capsules.		
	Stomach.	Thirst and bad appetite when admitted and for some time after. Gastrodynia.	Want of appetite. No sickness.
	Vomitus.		
	Intestines.	×	B. not loose.
	Dejections.		
URINARY ORGANS.	Kidneys, etc.		
	Bladder and urethra.		
	Urine.		
SEXUAL ORGANS.	Male organs.		
	Ovaries.		
	Other female organs.		
LOCOMOTIVE ORGANS.	Muscular system.		Very feeble.
	Osseous,		Acute necrosis of nearly whole femur; opened 7th d. Acute necrosis near ramus of jaw. (Lt.) beginning April 1st; opened April 6th.
	Articular, and	Pain, redness, and swelling of many joints.	
	Fibrous systems.		
	Adipose and areolar tissues.		
	Integuments.	Perspiration.	Skin dry all along. A few sudamina.
	Aspect.		Face much flushed at beginning. Aspect of typhus.
	Operations and date of operations.		
	Remarks.	Treated with lemon-juice, then with potash, and occasional hot-baths.	Complained of illness 12 hours only before admission. First symptoms, pain in thigh, coming on without obvious cause.
	Name of patient. Medical officer. Reference.	M. M. Lack. Dr. —— ——	J. Scully. Mr. —— ——

1. Duration, in the first two lines, is intended to be duration up to the time of entering hospital.

2. Practically, it has been found convenient to place information relating to "pain" (neuralgic, or of other kind) under the head of nerves.

3. Where two lines are bracketed, the intention is that, in cases where it is impossible conveniently to separate the description of the two or three organs thus bracketed, the combined description shall either extend over the whole space or be limited to the central part of the space.

4. Where more than one organ or tissue is involved in the same disease, the fact should be repeated under each head; thus, when *joint-disease* is mentioned under its appropriate heading, it will be often proper to mention *caries* under the head of bones.

5. It is sometimes desirable to give the duration of a symptom, or the time at which it commenced or ceased. This may be conveniently done by making the day of admission the starting-point of reckoning, and by speaking of time in days; thus, duration, 14 d. to 16 d., indicating a duration of three days inclusive, beginning from the 14th day after admission; or, 3 d. to 2 d., indicating a duration of five days inclusive, beginning from three days before admission.

6. A *line* placed under any remark indicates that the condition to which it refers is *important* or *grave*. And the degree of gravity may further be roughly indicated by the degree of thickness of the line.

7. A cross placed in any space indicates that the organ or part to which it refers was ascertained to be healthy.

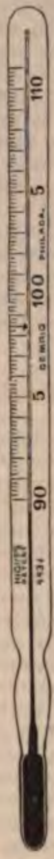
8. A horizontal line similarly placed indicates that, from some oversight, the condition of the part to which it refers *was not* ascertained.

9. A D or an M placed in the corner of a compartment is used to signify that the notes of the case contain a *detailed* description or a detailed *microscopic* account relating to the circumstances contained in the compartment.

[Since this article appeared, the use of the clinical thermometer has been very widely extended, and no form of registration, either for medical or for surgical cases, can be regarded as complete, which does not include records of the temperatures as observed from day to day, or morning and evening. "Temperature-charts" are generally kept separately, and the variations of the pulse may be placed on the same paper, so as to enable the observer easily to note the relation of these two important phenomena. (See Vol. I., p. 131.)

The observations are much more reliable if made with a self-registering instrument, such as is shown in fig. 975. The bulb may be placed under the tongue, in the axilla (wiped dry), or in the rectum. It is better from time to time to test the accuracy of the instrument, by having it compared with a known standard. Normally, the temperature is 98.5° Fahr., with a very slight range of variation. Any marked departure from this point is indicative of disturbance, grave in proportion to the degree of elevation or depression of the body-heat.]

Fig. 975.



Clinical thermometer.

The importance of anatomical knowledge and anatomical examination in surgical diagnosis is greater than that of any other of the sources of diagnosis. This will be best illustrated by the following remarks on REGIONAL SURGERY.

REGIONAL SURGERY.

The object of the following pages is to give, in as few words as possible, the main considerations by which the surgeons ought to be guided in distinguishing from each other the affections of the various regions of the body, so far as those considerations depend on the structure of each region. Such a treatise, if completely executed, would embrace all the points at which surgery and anatomy touch each other, and would therefore extend over the greater part of the theory of surgery; but, as most of these points have been fully treated of in the body of this work, it will suffice for me here to give a general view of the leading features of the anatomy of each region, and to dwell more particularly on such diseases[1] as have not found a place in the previous pages.

Of the Head.

The regional anatomy of the scalp and skull is simple. The parts present merely a series of laminæ overlying the cerebrum. These laminæ may, for surgical purposes, be divided into the hairy scalp, including the skin and the tendon of the occipito-frontalis muscle, with the large vessels contained between them; the cellular interspace between this tendon and the pericranium, in which the smaller vessels ramify; the pericranium and skull; and the membranes of the brain. It is unnecessary to attempt here any summary of the well-known points connected with the normal anatomy of these various structures. The point of chief importance in the case of any morbid product in this region is to determine from which of the laminæ it has sprung. This knowledge will of itself frequently determine the nature of the disease, and will at any rate give the most valuable indications as to the possibility of surgical interference.

1. The affections of the superficial layer—the hairy scalp—do not, as a general rule, lead to any difficulties in diagnosis; nor need the reader be detained here by observations on such affections as erysipelas, the cutaneous eruptions, the ordinary forms of nævus, of innocent tumor, or of cancer—affections which have been treated of in other parts of this work.[2]

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been clearly set before the
A tumor in other parts of
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and in which pressure doe
brain, may fairly be pron
In a few such tumors, the
sinuated underneath the
a depression in the skull.
pression may be due to pe
outer table only,[1] it does

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[1] It must be remembered that all injuries will be found in our first volume, described in the same regional classification as that which is here adopted.

[2] I may perhaps notice that all the affections of the scalp are essentially cutaneous, and that the malignant affections are exceedingly rare. Almost all tumors are of the encysted variety; but I
fatty tumor here.

[1] Mr. Athol Johnstone me
of these perforating sebaceo
one, at an operation for seb
the scalp, the bone was found
dura mater was injured; a

contra-indicate operation; but it would be advisable before operating to be satisfied of the decided increase in size of the tumor. Even if no depression can be felt, the skull may still be perforated; so that great caution should always be used.

With respect to the pulsatile tumors of the scalp, which are formed by dilatation of the large arteries below the skin, their anatomy and treatment has been described in the essay on ANEURISM, Vol. II., p. 391;[1] and an allusion has been made to the occasional difficulty of distinguishing them from malignant tumors of the skull, in the essay on DISEASES OF THE BONES (Vol. III., p. 180). The presence of cerebral symptoms on pressure is a clear diagnostic mark, and ought absolutely to forbid any operative interference; but any appearance of morbid action in the skull at the seat of the tumor — more particularly thickening without signs of inflammation—should render the surgeon very cautious in his diagnosis.

2. The occipito-frontalis tendon forms, in an anatomical description, the second of the layers of tissue which protect the brain: but as the surgical affections of this tendon could not be distinguished from those of the skin to which it is firmly attached, it may be neglected in this place. We come then to the cellular interspaces between the tendon and the pericranium, to which the tendon stands in the same relation as the deep or muscular fascia does to the cellular interspaces in the other parts of the body. In this interspace the most ordinary affection is the diffuse inflammation so common after scalp-wounds; but this has been already treated of in the essay on INJURIES OF THE HEAD, Vol. I., p. 603. Effusions of blood sometimes take place in the same space, and lead to interesting questions of diagnosis and treatment. Such effusions, as far as I have seen, occur only in early childhood, and are probably always the result of accident: although the occurrence of the blow or fall may not always be known, since no mark may have been left. The fluctuating swelling may extend over the whole scalp, or over a large part of one side of it, being generally more prominent in the temporal region.

When this blood-tumor extends over the whole head, I have seen it mistaken for hydrocephalus—from which, however, there should be no difficulty in distinguishing it; since the forehead has not the characteristic shape of that disease, the bones are not thrust out, and the skull can generally be detected underneath the fluid. From cephalæmatoma it may be diagnosed by its position, since the latter is confined in ordinary cases to the parietal bone; by the history—the one being congenital, the other usually not; and by the absence of the defined ridge which encircles a cephalæmatoma. When a large artery has been injured, these blood-swellings sometimes pulsate, and increase very rapidly in size, so as to require active treatment. Two courses are then open: either to cut across the swelling, and endeavor to find the wounded vessel, or to tie the vessel at a higher point The latter course is only possible when pressure on some branch (most probably one of the superficial temporal arteries) will arrest the pulsation. In such a case Mr. Athol Johnstone tied the temporal artery with complete success. The tumor was of large size; and to have laid it completely open and evacuated the contents would have been a severe operation, and possibly might have been accompanied by a good deal of hemorrhage.

In ordinary cases little treatment is required.[1] Under the use of evaporating

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died. The case occurred abroad. The preparation was presented to the Royal College of Surgeons by Mr. Prescott Hewett. In two other cases, Mr. Johnstone, in dissecting out sebaceous tumors, found a small perforation in the bone beneath them. No ill consequences occurred. In the fourth case, in an infant who died from other causes, a sebaceous tumor was found lodged in a depression in the bone just above the orbital arch, but not perforating the bone (Lectures on the Surgery of Childhood, p. 15). M. Giraldès has published, in his Leçons cliniques, p. 342, an account of a singular case of congenital dermoid tumor of the skull, lying over the anterior fontanelle, and which was long mistaken for a meningocele, in consequence of the peculiar nature of the fluid evacuated from it by puncture. This was so precisely identical with the cerebro-spinal fluid that M. Giraldès, having punctured a spina bifida on the same day, was unable to distinguish any difference between their contents. However, at last, as he made no progress in the treatment of the case by repeated puncture and application of pressure, he determined to lay open the tumor. A flap was formed from the skin of the scalp, and then the tumor was exposed and opened. It was now discovered that there was no communication with the skull, and the cyst was therefore removed entire with perfect success.

[1] In speaking of the treatment of aneurism by anastomosis in that essay, I accidentally omitted to refer to Mr. Southam's case, published in the Med.-Chir. Trans., vol. xlviii., in which the disease was successfully treated by a combination of the ligature of the common carotid artery and the use of setons. Mr. Southam informs me that Mr. Nunneley and another surgeon have also treated cases successfully in the same way.

[1] On the treatment of blood-tumors reference may be made to the essay on CONTUSION, Vol. I., p. 625.

lotions, the tumor gradually subsides. But if it continues in a chronic condition, it is justifiable to puncture and empty it; employing at the same time carefully-adjusted pressure. I once treated such a case in this manner, and had the opportunity of dissecting the parts a few months afterwards, the child having died of another disease. I found no traces of the collection of blood, except some decolorized fibrin and a few stratiform clots, bound down by a layer of false membrane.

3. The next layer of tissue is formed by the pericranium and skull. The blood-tumor, which is produced by pressure on the infant's head during delivery, and which is called cephalæmatoma, is smaller than the sub-aponeurotic extravasations above spoken of, appears in a few hours after birth, is situated on the parietal bone, and is bounded by a distinct ridge. The same ridge, bounding a small round circumscribed collection of fluid, is also familiar to surgeons as a frequent symptom in blows on the head, and a frequent cause of mistake to inexperienced observers, who confound these appearances with those of depressed fracture (see Vol. I., p. 612). Such extravasations from blows always disappear spontaneously; nor is there any more reason for surgical interference in cases of cephalæmatoma.[1]

The affections of the skull are by far the most frequent and the most important of those which attack this region. They may be divided into—1, the results of simple inflammation, acute or chronic; 2, scrofulous affections; 3, syphilitic affections; 4, tumors, innocent or malignant. Possibly also simple hypertrophy might be added to the list; but I have never been able to satisfy myself of the existence of this affection apart from the results of chronic inflammation.

The diagnosis and treatment of these affections may be thus stated in a tabular form:—

[*See Table on pp.* 924–5.]

4. After the affections of the skull come those diseases of the cranial contents which fall under the notice of the surgeon; that is to say, the tumors projecting through the cranium. Inflammatory affections of the meninges arising from constitutional causes, and the distension of the membranes or of the ventricles of the brain from hydrocephalus, come more properly under the notice of the physician; nor can we here enter upon the wide question of their diagnosis and treatment. The intracranial inflammations which follow injuries are treated of at Vol. I., pp. 659 et seq. Our present subject will comprise congenital tumors arising from malformation (meningocele and encephalocele), and the numerous forms of tumor which were originally described by Louis as fungous tumors of the dura mater; to which a few words on chronic hydrocephalus must be added, in order to illustrate and explain the surgical operation of paracentesis capitis.

Encephalocele and meningocele are tumors formed by a hernia of the membranes of the brain through the skull, in one of the parts where the bones are deficient in early life. In encephalocele a portion of brain also lies outside the skull, while in meningocele nothing protrudes except a bag of the membranes filled with subarachnoid fluid.

The tumors so formed are soft, rounded, bluish in color where covered by thin skin,[1] and from their congenital formation, their color, and their increase in size when the child cries, are often mistaken for nævus. It is also often difficult to distinguish them from congenital encysted tumors, and sometimes perhaps impossible before operation.[2]

The pathological anatomy and diagnosis of such tumors is an important and interesting question, to which much attention has been paid by Mr. Prescott Hewett, who has explained the subject very clearly in a course of lectures delivered by him as Professor of Surgery at the College of Surgeons, but not yet published.[3] I cannot affect to add anything to the information then first collected on this head, nor in the space at my command even to adequately sum up all the points connected with it; but must be content if I can succeed in indicating those which are of the chief practical importance.

That which appears the leading consideration in the anatomy of these hernial tumors is the condition of the contained organs, since if these could be known or assumed to be healthy, treatment might be justifiable, and vice versâ. It is important, therefore, to know that in hernial tumor of the skull, even if nothing but the membranes protrude, yet there is almost, if not absolutely, always more or less of internal hydrocephalus. In a preparation in the Museum of St. George's Hospital a cyst is seen adhering to the skull by a pedicle which runs down to the anterior fontanelle, the situation of the fontanelle being occupied by a large Wormian bone, which nearly closes it.[1] The pedicle of the tumor is entirely solid, and the cyst was punctured during life without any detriment, though without benefit. From the length of the pedicle, and the perfect closure of the orifice of communication, there can be no doubt that this tumor might have been removed by operation with fair prospect of success, in fact the meningocele may be said to have been spontaneously cured. Yet the patient died at the age of six weeks; and on examination there was found a large collection of fluid circumscribed in a part of the arachnoid cavity, and communicating with a dilated lateral ventricle through an opening in the distended corpus callosum. In another preparation in the same Museum the cyst, which is in the occipital region, contains no brain, but it leads through a small opening into the cavity of the fourth ventricle, which, as well as the whole ventricular cavity, is enormously dilated. In a case which I treated by iodine injection, and in which the infant died from another cause, the same dropsy of the ventricles existed. The case is described and figured in vol. i. of the St. George's Hospital Reports, and the preparation is also in the Museum of the Hospital. Therefore, in the case of infants, the first point to be remembered is, that there is every probability of the presence of internal hydrocephalus; and it is not until the perfect mental and physical power of the patient is ascertained, by long watching of the case, that the question of surgical treatment ought to be discussed.

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[1] For a more full account of cephalæmatoma the reader is referred to Dr. West's Lectures on the Diseases of Infancy and Childhood.

[1] In these tumors, as in spina bifida, the cutaneous covering may be deficient, and the membranes exposed; but this is still more rare in the head than in the spine. Von Bruns, Hand. d. prakt. Chir., vol. i., p. 701.

[2] See the case referred to in the note on pp. 920–21.

[3] The best published account of this subject is to be found in the work of Von Bruns above referred to.

The next question of primary importance in the anatomy of such a tumor is, whether or not the brain protrudes into the sac. It is only seldom that the pulsations of the brain can be detected:[2] when this is the case, there can be no doubt of the existence of hernia cerebri; but in ordinary cases, where no such pulsation is found, there is no reason whatever for assuming the absence of the brain from the sac. The mass of fluid lying over it may mask its pulsation, or the protruding portion of brain may be only a small piece rising just up to or just beyond the level of the skull.

The situation of such tumors is very variable. The most common is in the middle line, and usually at the back of the head, through an opening in the occipital bone behind the foramen magnum, at the junction of the four centres which form "the proral portion" of that bone; but any of the membranous portions of the infant skull may yield to the pressure of the fluid collecting inside, and become the seat of the hernia. Thus encephalocele is seen at the root of the nose (between the two halves of the frontal bone), at the anterior or posterior fontanelle, between the frontal and sphenoid or temporal bone, etc. The tumors in the anterior and superior regions of the skull communicate with the lateral ventricle; those in the lateral region with the lateral or the third; those in the occipital region with the fourth ventricle. Hernial tumors have also been found in the base of the skull, probably communicating with the third ventricle.[1] A short time since a tumor was presented to the Pathological Society by Dr. Lichtenberg,[2] which he had removed from a child's mouth, into which it projected from the pharynx, hanging out over the chin, so as to touch the sternum. This turned out to be a hernia of the brain through the base of the skull. The operation of course proved fatal.

The diagnosis of the tumors rests, first, upon their congenital occurrence and position, at one of the membranous portions of the fœtal head; next, upon their fluid nature; thirdly, upon their considerable and decided increase in volume or tension with strong expiratory efforts; fourthly, upon their reductibility in part or entirely; and fifthly, upon their sharing in the motions of the brain. All the three latter marks will be absent from those tumors in which (as in the instance quoted above) the pedicle has been obliterated; but such tumors cannot be accurately diagnosed. Another source of difficulty in diagnosis is that these hernial tumors are occasionally multilocular, and then the fluid is not reducible. This was the case in my patient, referred to above. In some other cases also the diagnosis must be allowed to be very difficult. I have seen a congenital tumor lying on the root of the nose, and rightly believed to be a common encysted tumor, in which, however, before operation, it was impossible to be quite certain of its nature. In another case the hernial tumor was cut into, in mistake for a sebaceous cyst, and a small portion of brain substance, proved to be so by microscopic examination, was removed. Fortunately no harm ensued.

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[1] A drawing of the head, taken during life, is also in the Museum.

[2] As in Mr. Shaw's case, in Path. Soc. Trans., vol. ix., p. 1.

[1] Serres, Journ. de Chir., par Malgaigne, 1844, vol. ii., p. 335.

[2] Path. Soc. Trans., vol. xviii., p. 250.

TABLE OF THE CHIEF SURGICAL DISEASES OF THE SKULL AND PERICRANIUM.

DISEASE.	LEADING SYMPTOMS.	DIAGNOSIS.	TREATMENT.
Acute inflammation: periosteal.	Very severe pain, especially nocturnal; sense of tension; much tenderness; slight swelling, bound down firmly by pericranium.	From tumor of brain or membranes by its more rapid course, and absence of cerebral symptoms. From simple cephalalgia or neuralgia, by the swelling, the persistence and regularity of the symptoms, and the constitutional disturbance. From the following, by the absence of suppuration and of symptoms of implication of the brain and membranes.	Free incision into swelling, with constitutional measures.
" " osteal (acute necrosis).	As above: with rapid formation of pus, and probably irritation or suppuration on the other side of the bone, with cerebral symptoms. In rare cases, ulceration of the middle meningeal artery occurs, followed by hemiplegia.	This may be inferred from the preceding.	Free incisions. Trephining is imperative, when symptoms of pressure are clearly marked, and may be justifiable in some cases of mere irritation.
Ulceration.	Inflammation, with suppuration,[1] followed by perforation of the skull, and, in rare cases, hernia cerebri.	In rare cases, when hernia cerebri occurs before the skin has given way, the disease has been mistaken for malignant pulsatile tumor. V. infra.	To attend to the general health and relieve pain by incisions where fluid is apparent.
Chronic inflammation and hypertrophy.	Rarely any symptoms: coma has been observed occasionally; but its connection with the state of the skull has not been demonstrated.	Obscure.	No treatment is possible, except for the brain-symptoms, which (as their cause would be obscure) must be treated as they arise.
Necrosis and caries.		Obvious.	When symptoms of cerebral irritation are present, the bone (especially when not implicating the whole thickness of the skull) may be removed.
Scrofulous affections:[2] tumor of the skull.	A large hard swelling, on the side of the head, much resembling an exostosis; but accompanied by headache, and symptoms of low inflammation in a scrofulous person.	From diffused exostosis, by the less-circumscribed character of the swelling, and the presence of symptoms; but mainly by the effect of treatment.	Blisters or iodine to the part. Iodine, with iron, or cod-liver oil, internally.

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[1] In one case, much resembling ulceration of the cranium, there seems to have been no suppuration previous to the incision. See Cæsar Hawkins, in Med. Chir. Trans., vol. xxxix., p. 289.

[2] The ordinary constitutional affections are not mentioned, as they are merely the common inflammatory affections *plus* those of the diathesis.

TABLE—*continued.*

DISEASE.	LEADING SYMPTOMS.	DIAGNOSIS.	TREATMENT.
Syphilitic affections[1] of the internal table.	Circumscribed pain in head; irritation of membranes, producing fits, and in rare cases hemorrhage from middle meningeal artery; with other symptoms of constitutional syphilis.	From syphilitic disease of the brain itself[2] only to be diagnosed with certainty by a surgical operation.	When life is seriously threatened it will be justifiable to trephine at the seat of pain; or, in still more rare cases, over the middle meningeal artery.[3]
Tumors: innocent: exostosis.	A small and very hard tumor growing very slowly, and unaccompanied by any symptoms except in very rare cases, when the exostosis grows from both tables, or in the orbit when it displaces the globe.	From diseased enlargement of the bone by the presence of symptoms in the latter, and by their less distinct and circumscribed outline.	Operative interference is seldom justifiable.
fibrous or fibro-cystic.	A slowly-growing tumor, more soft than exostosis, and more liable to affect the brain by growing inwards.	From exostosis as above: from cancerous tumors by its less rapid growth, and by the other usual diagnostic marks; from fibrous tumor of the dura mater the diagnosis is obvious before perforation of the skull has taken place, but impossible afterwards.	No interference is permissible. Life may be prolonged many years even after the tumor has produced pressure on the brain and cerebral symptoms.
myeloid or fibro-plastic.	The same observations apply to the symptoms, diagnosis, and treatment of these forms of tumor, with the exception that their course is more rapid, and that in all other respects they bear a closer resemblance to malignant disease.		
malignant.	Circumscribed pain in head; soon followed by the appearance of a tumor, or by softening and pulsation at the seat of pain. The tumor grows rapidly, and soon produces pressure on the brain. The malignant cachexia is usually well marked. The skull is usually thickened around the tumor.	From innocent tumor by its more rapid course, and by the constitutional symptoms. From hernia cerebri, following absorption of the skull (very rare), by the greater violence of the pulsation, the absence of the movements of the brain dependent on the respiration, and the less uniform consistence of the tumor. From vascular tumor (or aneurism by anastomosis), by the cerebral symptoms which are induced by pressure, as well as by the signs of cancer.	No treatment is possible.

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[1] The ordinary constitutional affections are not mentioned, as they are merely the common inflammatory affections *plus* those of the diathesis.
[2] Such as described and figured by Mr. H. Lee, Proc. of Med.-Chir. Soc., vol. iii., p. 283; Path. Soc. Trans., vol. x., p. 8.
[3] See a case by Mr. H. Lee, Med. Times and Gaz., Jan. 29, 1859.

As to treatment, few surgeons would propose to meddle with a hernial tumor of the brain, knowing it to be such, unless it was distinctly increasing, and the patient's life was obviously imperiled. Unfortunately this is just the case in which there would be least prospect of benefit, since the rapid increase in the tumor depends, in all probability, upon the rapid secretion of fluid from the lining membrane of the ventricles or the arachnoid; and the obliteration of the tumor, if it could be effected, would only hasten the epoch of fatal pressure. But, in some very rare cases, it may be thought justifiable to interfere, even if the tumor is known to be connected with the interior of the skull, since it may be growing so rapidly, and be so near bursting, that it may seem more dangerous to leave it alone than to operate on it. In such cases puncture of the swelling and carefully adjusted support (rather than pressure) afterwards by means of a pad and bandage, of such materials as may be judged best, are the most advisable operative measures. Tumors of this kind have been removed by excision and ligature, having been mistaken for other growths; but this is a course which should only be knowingly followed in the very rarest cases. In all cases it is advisable to give careful support to the tumor, and to defend it from irritation or injury; and in those tumors which are reducible, if no cerebral symptoms are produced by their reduction, an apparatus should be employed to keep them down to the level of the cranium. This has sometimes been followed by the ossification of the skull-cap and the cure of the disease.[1] Injection of iodine has been tried, as in spina bifida, but hitherto, as far as I know, without benefit. Mr. Paget treated a case in this way, without any very obvious result, though the disease remained stationary for a length of time afterwards.[2] I have already referred to a case under my own care, in which also the injection, though frequently repeated, produced no effect on the tumor. In that case, had not the child's life been cut short by an accidental attack of bronchitis, I intended to have attempted the excision of the tumor.

Tumors of the dura mater and diploë.—Since Louis wrote his celebrated memoir on fungous tumors of the dura mater,[3] the attention of surgeons has not ceased to be directed to those perforating tumors of the head which he desc
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[1] Von Bruns, op. cit., p. 715.

[2] Path. Soc. Trans., vol. xvi., p. 12.

[3] Translated by Mr. Drewry Ottley in a volume of selections from the Memoirs of the Academy of Surgery of Paris, published by the Sydenham Society

[1] Compare the cases numbe

[2] *E. g.*, by Cruveilhier, A
33, pl. 4.

[3] Path. Chir., vol. ii., p. 63

rily, but grew again and proved to be cancerous.

If the question of the treatment of such tumors need discussion, little can be said beyond urging the propriety of not meddling with them. This again might seem almost unnecessary; but it is surprising how often, either from mistakes in diagnosis, or from inability to resist the patient's entreaties, surgeons do commit themselves to an attempt at such operations. Such attempts, however, are unjustifiable on every ground. It has been stated above that these tumors are innocent or malignant. In the former case, an operation will probably hasten death; and in the latter, it will certainly not retard it. The innocent tumors are by no means necessarily fatal.[1] No operation could be of any avail short of one which would remove the whole of the skullcap around the diseased parts, and allow of the avulsion of the tumor from the dura mater; and although instances of recovery from such barbarous proceedings are on record,[2] they would not now be attempted. But to cut into a tumor of this sort, with no prospect of removing it entirely, is surely still less justifiable. In cancer no operation should ever be thought of, unless there is almost a certainty of removing the whole disease; and this rule is the more absolute, the more vital the organ is in which the disease occurs.

Hydrocephalus. — Surgeons are sometimes consulted with respect to surgical measures in cases of chronic hydrocephalus; and hence it becomes necessary to say something in this place about this disease, as far as relates to its surgical treatment. The acute affections of the brain (encephalitis, acute hydrocephalus, or strumous meningitis, etc.), are so exclusively the province of the physician, that they will not be mentioned here; more especially as it would be impossible to do justice to the subject without more space than is at my command. The effusion in chronic hydrocephalus may be external or internal to the ventricular cavity; it may depend on malformation of the brain, on atrophy, on chronic inflammation, or on injury; and the curability of the disease depends so essentially on these circumstances, that they must be maturely weighed before an opinion for or against surgical interference is given. Cases of external hydrocephalus (*i. e.*, of dropsy of the arachnoid cavity) are usually regarded as less hopeless than those of dropsy of the ventricles. The diagnosis of the two conditions is by no means certain in any case; in fact, Dr. West[1] says that their symptoms are nearly identical; but some indications can be drawn from the history, and a probable guess at any rate may be formed from the appearance of the eyes. In those cases of hydrocephalus which are congenital there is usually extensive malformation of the brain, and the fluid may be expected to be found in the cavity of the ventricles, although it is not unlikely that there may also be fluid external to the brain. At any rate treatment will be useless. In cases, on the other hand, which can be clearly traced to injury, the probability will be that the fluid is external; and there will be more hope from treatment. In atrophy of the brain, the hydrocephalus will be external; in chronic inflammation, internal; but I know of no symptoms or facts from which these conditions may be diagnosed.

The aspect of a case of hydrocephalus is very peculiar. The fontanelle is widely expanded and often very tense; the sagittal and frontal sutures are opened out, and thus the two halves of the frontal bone are driven outwards, and the frontal eminences project on either hand, giving a peculiar square shape to the head, and great height to the forehead. The base of the skull is driven downwards; and thus the orbital plates of the frontal bone are pushed into the orbit, displacing the eyes, which look outwards and downwards, and are also more prominent than natural. Frequently, also, the eyes have that unsteadiness of action and vacant expression which accompanies partial blindness in infancy. The occiput is driven more or less downwards and backwards. On feeling the head, in an old-standing case, isolated patches of bone (Wormian bones) will often be felt in the sutures. Very large veins ramify over the thin scalp, and the fluid often shines through its attenuated coverings.

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[1] There is in St. George's Hospital Museum a preparation showing a fibrous tumor of the skull and dura mater, which had perforated the latter membrane and was lying on the brain, from which it received a very decided pulsation. The patient suffered from occasional fits, loss of memory, vertigo, and sickness; but he survived the appearance of the tumor more than fifteen years; and finally died, at a tolerably advanced age, of a disease quite unconnected with that on the skull.

[2] Louis, op. cit., obs. 19, p. 114; a case in which a piece of bone, six and a half inches in circumference, was removed by the application of numerous crowns of trephine on several occasions; and a "fungous substance" was said to have been removed from the dura mater. The whole description and history, however, seem to show that this was merely a case of caries of the skull, and the fungous substance only the product of inflammation.

[1] Lectures on the Diseases of Infancy and Childhood, lect. ix.

Of these characters, the position of the eyes is different in external and internal hydrocephalus, inasmuch as the displacement of the base of the skull depends mainly on accumulation in the ventricles; and therefore the eyes are less likely to be driven out, when the fluid is confined in the cavity of the membranes, since in all recorded cases the accumulation in external hydrocephalus has been limited to the vertex of the skull.[1]

Surgical treatment.—If the child be in fair general health, and not obviously beyond hope of relief, the question occurs whether mechanical means will be of any avail in checking or removing the effusion. I am not aware that any success has attended the use of internal remedies. I have often made patient trial of mercury, and believe it to be quite inert, as far as procuring any reabsorption of the fluid goes. Nor can I say that I have found any benefit from mercurial or other applications to the scalp. Pressure on the skull, or puncture of the fluid collection (paracentesis capitis), are the only means which hold out any rational prospect of benefit; and although I cannot recall any case of success under my own observation, I do not dissuade from their use whenever the disease is not congenital, or accompanied by other malformation, or complicated with symptoms of active disease. There seems more prospect of benefit from using the measures simultaneously than separately. In puncture of the skull a point must be selected away from the middle line, in order to avoid the sinus, and away from any large vein. A very fine trocar should be used, and only a very small quantity (say two ounces) of fluid withdrawn, careful compression of both sides of the skull being maintained meanwhile. If convulsions come on, the instrument should be at once withdrawn. A cap should be in readiness, made of sheet-caoutchouc, perforated with small round holes, to avoid heat of the head, and while unstretched slightly too small for the head, and this should be applied directly on the withdrawal of the canula. If the child's condition is improved, or not made worse, by the first puncture, it can be repeated in a few days, but not in the same place. The operation, however, is often followed by convulsions; and it has seemed to hasten death. Still the disease itself is so miserable and fatal, that anything which holds out a prospect of relief, and does not entail suffering, may be tried. I have sometimes contemplated the possibility of injecting iodine in this disease, but have not hitherto met with a case in which I could think the attempt justifiable.

Almost every case of chronic hydrocephalus proves fatal, if the effusion is so extensive as to cause obvious increase in the size of the skull. At the same time, a few patients survive to maturity, as the man (Cardinal) whose bust is in most pathological museums, and who lived to the age of 29; and in a few cases the affection disappears by spontaneous cure. In some cases, where, without obvious malformation, there is some defect of intellect or temper, the only post-mortem appearance has been internal hydrocephalus to a slight amount. Such was the case in the body of a youth, otherwise well formed and healthy, who was beaten to death by his schoolmaster a few years ago. The brain was well formed; but the ventricles large, slightly compressing the convolutions, and containing a large quantity of limpid serum.

A case was related to the Royal Medical and Chirurgical Society, by Dr. Thompson, of Newcastle-on-Tyne, in which a collection of fluid formed after a contusion received by an infant two weeks old, and gradually produced all the symptoms of external hydrocephalus. The head was twice punctured. At the first operation, clear watery fluid was drawn off, and continued to ooze from the puncture for some time. Convulsions occurred ten days after the operation, attributed to the cutting of some teeth. Another puncture, five weeks after the former, proved permanently successful: the fluid drawn off was more milky. Neither specimen seems to have been analyzed.[1]

The Face.

The regional surgery of the face demands but little consideration in this place, since the greater number of its affections have been spoken of in other parts of the work. Thus the operation for remedying the deformities which are so frequent in this part will be found treated of under the head of PLASTIC SURGERY; salivary fistula under INJURIES OF THE FACE; and all the various affections of the MOUTH, JAWS, and GUMS under those headings. The tumors situated in the cheek and parotid region, however, have not been elsewhere described; and as they are of frequent occurrence, and of much surgical interest, we must devote a little space to this topic.

Tumors.—The most frequent tumor in the cheek is the common sebaceous cyst, which in male subjects is developed in front of the ear (*i. e.*, in the hairy part of the face), only a little less often than it is found in the hairy scalp. Its diagnosis is obvious, and its treatment easy; but when it dips down more deeply than usual, and lies near Steno's duct, care must be taken, in dissecting it out, to keep close to the cyst. These cysts can in this region be removed most readily by slitting them across with the skin; and this plan also involves a more limited incision, which is an important consideration here. The incision should be horizontal, and the knife be kept as much as possible in the horizontal direction, in order not to wound the duct or nerve.

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[1] This point was elaborated by Mr. Prescott Hewett in his lectures at the Royal College of Surgeons.

[1] Med.-Chir. Proc., June 28, 1864.

Cysts of other kinds are also occasionally seen.[1] I have treated one in the substance of the cheek, in a child five years of age, attributed to a blow received in very early infancy, and containing fluid exactly resembling blood. Iodine injection was practised, and I believe successfully; but the patient was lost sight of before the event of the case could be positively affirmed. I have also seen watery cysts in the neighborhood of the parotid gland; but the most frequent tumor in this part is the *glandular parotid tumor*. This is a firm hard lump, situated generally below and behind the lobe of the ear, but sometimes in front of it, and is probably developed in one of the absorbent glands which lie over the parotid in that situation;[2] or it is supposed by some authors to be occasionally developed in the fibrous envelope of the gland. It bears a striking analogy to those glandular (adenoid) tumors which lie in the neighborhood of other glands, such as the mammary and the prostate, and is described by a recent French author as a hypertrophy of the parotid.[3] It grows slowly, displacing the parotid gland, pressing more or less on the parts contained in that gland, and sometimes burying itself deeply behind the ramus of the jaw. Its structure is very firm and solid, consisting usually of well-formed fibrous tissue, mixed with glandular elements, in which portions of cartilage are often found; and it frequently has one or more cysts in its interior. Its continued growth produces deformity, frequently loss of hearing or difficulty of mastication, and more rarely palsy of the features on the affected side; and so its removal is very desirable. But the operation is often attended with unpleasant, and sometimes even dangerous, consequences, from lesion of the large vessels and of the facial nerve; therefore some caution should be exercised, both in giving an opinion on the probable result of the case, and in operating on the tumor. As with tumors in the neck, the main element of safety in these operations is to have a very free access to the surface of the tumor in some position where it can be approached safely, which in the parotid tumor will be at its posterior edge. For this purpose a T-shaped incision will be most convenient, the vertical line passing down the posterior edge of the tumor. The growth will generally be found enclosed in a distinct capsule; and if the latter be freely opened, and the knife kept close upon and directed towards the surface of the tumor, the operation is usually completed without accident.[1] But the position of the facial nerve, the external carotid artery, and the large trunk which forms the commencement of the external jugular vein, must be carefully kept in mind. I have often seen each of these parts wounded; and, indeed, it may be mechanically impossible to remove the tumor without dividing the nerve. If the artery is wounded, this happens generally in the last stage of the dissection, and there is frequently no difficulty in securing it. When the tumor passes into the neck, its removal is of course more hazardous; as also when it dips under the ramus of the lower jaw. If the trunk or a main branch of the facial nerve has been severed, a most unpleasant drawing of the features is the immediate result; and this condition is very likely to remain permanently. It is true that simple wounds of nerves rapidly heal, and often without loss of function; but the division of a nerve in the cavity of a large wound, where the cut ends may not be in contact, or may become separated afterwards by inflammatory products, is another matter.[1] However, palsy of the nerve may be produced by inflammation occurring in its neighborhood, without any wound, or with only a slight injury to the nerve itself; and this palsy will be transient. The circumstance will be distinguished by the fact of the palsy not occurring instantaneously after the operation, and being at first incomplete. If the tumor should extend far forward, Steno's duct is endangered, and may be divided, leading to a salivary fistula, which, however, if treated in the usual way, may prove curable.[2]

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[1] Short references to several cases of cysts of various kinds situated in the face may be found in Jamain, Manuel de Pathologie et de Clinique chir., vol. ii., p. 42. Care must be taken to distinguish between a watery cyst and a collection of fluid in the expanded duct of the parotid from wound or obstruction of that duct. Cases of this latter affection will be found described by Jarjavay, Mèm. de la Soc. de Chir., vol. iii., p. 492. It will be recognized by the position of the swelling, its increase in volume during mastication (when possibly some slight escape of saliva may take place through minute openings on the skin of the cheek), and the dryness of that side of the mouth. The treatment consists in reestablishing the opening into the mouth.

[2] See the figure by Mascagni of the lymphatic system of the face, reproduced in Gray's Anatomy, 8th ed., p. 591.

[3] Bauchet, in Mèm. de la Soc. de Chir., vol. v., p. 289.

[1] A case related by Vanzetti, Observation de tumeur fibreuse de la parotide, Bull. de la Soc. anat. de Paris, 1844, p. 40, in which the tumor was of very large size, and passed inside of the ramus of the jaw, will show the importance of recognizing and keeping within this capsule. When this is done, large portions can be detached without any cutting; and the capsule is sure to separate the operator from any important structure which may be endangered. See also Liston, Prac. Surg., 4th ed., p. 324.

These tumors are sometimes observed to recur, and in all probability this is usually in consequence of a portion having been left behind at the former operation; but the recurrence of adenoid tumors in other parts[3] should make us hesitate to admit that this is the only cause. The most interesting case is the one recorded by Langenbeck.[4] Here the original tumor was clearly distinguished, by its difference of appearance, from the substance of the gland in which it was imbedded. After a year it recurred. The extirpation was then difficult, and involved a wound of the facial nerve, and persistent facial paralysis. Five years afterwards the patient presented himself with a tumor beneath the sterno-mastoid, as large as a child's head, which adhered to the periosteum of the inside of the jaw, passed down on to the styloid process, rested on the sheath of the common carotid artery, and had the internal jugular vein imbedded in it. The extirpation of this tumor was nevertheless successfully effected, and even without injury to the vein.

The other tumors of the face derive too few peculiar characters from their anatomical relations to detain us at present. I would, however, just mention a very singular tumor, spoken of by MM. Bérard and Denonvilliers (Compend. de Chir., iii., 99), formed apparently by a distension of the frontal sinus, producing intense pain, displacement of the eye, and a large accumulation of gas in the superficial parts of the face communicating with the neck. The patient was under the care of M. Jarjavay, and recovered after the tumor had been laid open and had suppurated.

Finally, I ought perhaps to say a few words about those great tumors which sometimes spring from the bones of the face, and produce horrible deformity by driving the eyes out, distorting the features, etc. They have been alluded to in the essay on DISEASES OF THE MOUTH, Vol. II., p. 530, as "hypertrophies of the upper jaw-bone," the name by which Mr. Stanley described them. Some of them are of this nature; others are diffused enchondromata, springing from the base of the skull. In a very remarkable specimen, in St. George's Hospital Museum, described and figured by the writer in Path. Soc. Trans., vol. x., p. 250, the tumor almost fills the anterior fossa of the base of the skull, and has pushed both eyeballs completely out of the orbits, besides filling the nasal cavity and projecting on the cheeks. When such tumors have been less extensive, and free from cerebral symptoms, attempts have been made to remove them;[1] but these have failed in consequence of the extent of attachment of the tumor to the base of the skull. Very careful examination is therefore necessary before the surgeon commits himself to any such attempt; and it is only when there is sufficient reason for believing that the tumor has a comparatively narrow attachment, that the attempt holds out much encouragement. If the eyes are widely separated, and pretty equidistant from the middle line; if the parts of the tumor within reach are fixed to the bones of the face; and if ossification or calcification seems to be proceeding extensively in the mass—the obstacles to the operation will probably be found insuperable; nevertheless, it is quite possible that the removal of the cartilaginous surface of the tumor may at any rate arrest its growth; and in these frightful cases it is justifiable to run considerable risks. The absence of dilatation of the face from outward pressure of the malar or superior maxillary bones is a favorable diagnostic indication, as tending to show that the nasal cavities are alone implicated. But even then the base of the tumor may be so extensive or so remote that its complete removal is impossible.

The *opening of the mouth* is occasionally much narrowed and displaced. This occurs as a consequence of ulcerative and gangrenous affections of the soft parts, and sometimes also of the bones; from lupus, rodent, or cancroid ulcer of the face, mercurial ulceration, cancrum oris, burns, or wounds which have taken on an unhealthy action. The deformity is excessive; nutrition is sometimes seriously impaired from the limitation of the movements of the jaw, as well as the narrowing of the opening of the mouth; and an attempt at cure is imperative. In all such cases much care ought to be taken to ascertain, if possible, the condition of the parts inside the mouth. Sometimes the gums and cheeks are incorporated, or the jaws may be partially ankylosed. Frequently large masses of foul deposit exist around the teeth. If the parts within the mouth are very firmly adherent, and the mucous membrane greatly altered from its natural condition and cicatrized, there is not much hope of success from surgical operation; but if the mucous membrane be movable on the skin, an incision may be made outwards from the corner of the opening, a portion of the skin may be removed, leaving the mucous membrane, which is then to be divided, and the mucous flaps stitched to the edges of the skin. In this manner, if primary union be obtained, there is the less risk of the opening recontracting. Or, if this be impossible, two flaps of skin may be drawn down from the face and united to the edges of the incision, with their cutaneous surfaces towards each other. If these will unite kindly to the raw surfaces left by the incision, the readhesion of the edges of the wound, and its consequent cicatrization, with reproduction of the deformity, may possibly be obviated. But it must be allowed that the parts are often so diseased and scarred, both around the opening and for a long distance on the cheek, that neither of these plans is feasible. In the only case in which I have had an opportunity of trying this proceeding,[1] the substance around the oral opening was so completely altered in character, that it was impossible to separate mucous membrane from skin; while the parts on the cheek and chin were so changed from their natural condition, that it would have been hopeless to endeavor to transplant skin. Under such circumstances, as also when the parts inside are extensively cicatrized, it would be well to give a patient trial to dilatation by means of conical pads of ivory, compressed box-wood, or some similar smooth substance, so contrived as to make gradually increasing pressure against the opening.[2]

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[1] In a case related by Banchet, op. cit., p. 337, the operator, M. Lenoir, having recognized the two ends of the facial nerve, which he had divided, placed them in contact, and the paralysis was only transient.

[2] Salivary fistula occurred in 3, and facial paralysis in 3, out of 11 such operations related by M. Banchet.

[3] See DISEASES OF THE BREAST, p. 696.

[4] Archiv. f. klin. Chirurgie, i., 4.

[1] Viz., once by Mr. Morgan of Guy's Hospital, and again by Mr. Moore; the model of the head in the former case is in the Museum of Guy's Hospital.

Inflammatory affections about the parotid or other salivary glands are of very frequent occurrence; especially the trivial contagious affection so common in children, called the mumps, which consists in swelling of and around the parotid, submaxillary, and sublingual glands, accompanied with some pain and stiffness in using the jaw. It is ordinarily confined to one side at first; but is very liable to spread to the other. Generally it is quite devoid of danger, or, in fact, of any importance, and requires no treatment beyond a warm fomentation or poultice, with perhaps some saline diaphoretic. But cases in which the inflammation has been transferred (by metastasis, as the term is) to the testicle have been already referred to (Vol. II., p. 914); and the same thing takes place in the female mamma, though more rarely; while metastasis to the brain appears to have been noticed. These complications must be treated in the same way as similar inflammations excited by other causes.

Inflammation of these parts may also be excited by the use of sialagogue medicines, especially mercury; or inflammation accompanied by salivation may occur spontaneously. In the former case the disuse of the irritant, with the frequent employment of astringent gargles, and the internal administration of tonics with chlorate of potash and nutritious fluid diet, are the measures indicated. Spontaneous inflammation of the salivary glands is generally more rebellious to treatment: the general health and the local condition of the gums should be the first objects of inquiry and attention. If there be much swelling and tenderness about the parotid, leeches may be of service. When the inflammation has become chronic, the local application of iodine, or the careful use of mercurial ointments, is indicated.

These complaints are all of them liable to end in abscess; and such abscesses, bound down by the firm fascia which covers the parotid gland, are both painful in themselves and distressing, from the impediment they offer to mastication. They have been also known to burst into the meatus auditorius, and to burrow about to a great extent in the neck. They should be opened early; but it is desirable, in all affections of the face and its neighborhood, to avoid too free incisions; and if the opening be made sufficiently early, a mere puncture through the skin, with a tolerably free incision of the subcutaneous parts, including the fascia, will suffice. If a more extensive incision be required, the natural foldings of the skin must be studied, and its direction be made to correspond.

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[1] The case was reported by Mr. Sercombe, in the Med.-Chir. Trans., vol. xxxix., p. 95.

[2] See the essay on INJURIES OF THE FACE, Vol. I., p. 677. On this subject consult Wernher, Handbuch der allgemeinen Chirurgie, vol. iv., p. 18.

Abscesses are occasionally produced by calculi embedded in the duct of the parotid gland. The existence of such calculi in some cases of ranula has been already noticed, Vol. II., p. 270. Their composition is phosphate of lime, with a little triple phosphate. If such an abscess be allowed to burst externally or be opened on the cheek, a salivary fistula will probably result. Hence it is important to open the abscess and remove the foreign body (which can easily be felt) from the interior of the mouth.

The face is liable to be attacked by epithelial, rodent, and lupous ulceration. The nature of these various forms of disease has been discussed in other essays, and their diagnosis and treatment has been, as far as possible, pointed out. But the interesting question remains for discussion in this place, what resources has operative surgery in the treatment of these affections when they attack the face? Few surgeons of experience can have been without opportunities of witnessing the frightful condition which is induced by cancroid and rodent ulceration of the face. The features gradually and slowly yield to the progress of the disease; the soft parts are eaten away; the bones crumble, or become necrosed; the nose and mouth, and sometimes the orbit also, fall into one cavity, and yet the patient lives on, though frequently suffering terrible pain; and although presenting a condition of incurable mutilation, which no feelings of humanity can prevent our regarding with some amount of repugnance. The disease is too generally regarded as a hopeless one, and the surgeon is glad to escape from his patient. Yet, in the case of rodent ulcer almost certainly, and in many of the cases regarded as epithelioma very probably, if the disease were destroyed entirely and in its whole extent, the patient would be restored to good general health, the edges would cicatrize, and the gap in his features could be filled up by some of the many kinds of mask, or false features, which the ingenuity of our dentists and mechanics has produced.[1] Much encouragement for boldness in operating on such cases when occurring in the face may be drawn from the treatise of the late Mr. Moore on Rodent Cancer, where some striking instances of the success of the treatment are detailed. I may be allowed to cite the following passage (p. 52):—"The knife and caustic may be so combined that the surgeon shall extirpate the disease in a very advanced stage, protecting the patient absolutely from pain and shock by the use of chloroform, and the subcutaneous injection of morphia, and supplying by a suitable mask the shrunken gap which is left after the cicatrization of the wound. I first found how far such an operation could be carried in the case of Mary H., in which I removed all the margin and contents of the right orbit, with the bridge of the nose, and laid a paste of the chloride of zinc on the freshly-cut surface, which still presented fragments of the disease in the exposed portions of the bones. Before the patient awoke from the effects of the chloroform, I injected morphia beneath the skin, and under its influence she remained asleep for six hours, and awoke free from pain. In five weeks the inodorous slough came away, the wound healed, and the patient lived three years in comfort, wearing a vulcanite mask, which was skilfully moulded and painted to represent the defective features. Another patient who was under the care of Mr. De Morgan, after as extensive an operation, completely recovered, and afterwards not unfrequently enjoyed a day's shooting. . . . The advantage of this method of treating rodent cancer appears to consist in the completeness of the caustic action of the chloride of zinc. There is no expenditure of it upon the dense margin of the disease, but it acts directly upon the soft tissues which are exposed by the incisions. These apparently healthy, but really morbid parts are readily permeable by the caustic, and they can be destroyed to any depth which may be deemed requisite."

The Neck.

The chief points in the surgical anatomy of the neck are connected with the arrangement of the cervical fascia. This membrane has an arrangement in the neck somewhat similar to that which prevails in the limbs, although more complicated; that is to say, it consists of a system of long sheaths or tubes, which surround the muscles and the chief vessels, together with the trachea, and which take attachment to the bony framework of the part—viz., to the lower jaw above, the clavicle and ribs below, and the spinal column at the back. As the fascia lata, if traced upwards, will be found continuous with the iliac fascia around the femoral vessels, so the cervical fascia may be traced behind the sternum and ribs, till it becomes continuous with the outer layer of the pericardium. Now, the extensive connections of this fascia explain how it is that tumors, lying beneath it in the neck, may grow to such a size, may pass down in so many different directions, and may implicate such important parts before they have made enough progress externally to induce the patient to apply for their removal; how spreading affections, such as diffuse inflammation or abscess, may pass down into the cellular tissue of the thorax, and the disease thus be withdrawn from all possibility of successful treatment; and therefore why surgeons always regard operations conducted below the cervical fascia with apprehension, both on account of their immediate dangers, and their possible complications.

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[1] Much freedom in operating on these cases of epithelial ulceration is justifiable, in order to relieve the wearing pain which it occasions, even if for no other motive. A man above eighty years of age came under my care some years ago, begging for relief from the pain of an extensive epithelial ulcer of the eyelids. He was laboring under disease of the heart, and could not safely be brought under the influence of chloroform, but he had great courage, and submitted to the operation without complaint. I removed the whole of the lower and about half of the upper eyelid, down to the bone, and filled up the gap with a flap from the cheek. This united perfectly. He was freed from his distress, and no return of the disease took place up to the time of his death, which occurred from the heart-disease, in his sleep, about half a year after the operation.

The affections which attack the parts superficial to the cervical fascia do not call for much notice here. Sometimes, however, superficial tumors may be met with in this situation, which, either by the negligence of the patient, or the ignorance of those whom he has consulted, have been allowed to grow to a great size. A striking instance of this is the fatty tumor figured in Liston's Practical Surgery (4th ed., p. 321), and which was as large as the patient's head.[1] When above the fascia, these growths, whatever be their size, may be removed with as little risk as tumors of the same size in any other parts. The signs indicative of their being situated over the fascia, will be the readiness with which the finger can be inserted beneath them and then passed between their base and the larynx, or the sterno-mastoid muscle, their mobility, and the dimpling of the skin when moved over them, which is usually noticed in fatty tumors.

We pass on to consider that peculiar form of watery cyst which is described as *hydrocele of the neck*. This tumor is sometimes superficial to the cervical fascia, but usually more deeply seated; sometimes congenital, at others an affection of later life;[2] sometimes simply cystic, at others of a more complex anatomy. The first point to be established is the character of the tumor, and the next its situation. Simple watery cysts, or true hydroceles, are such as are destitute of all solid base, and contain frequently a purely watery fluid; at other times, more or less of the constituents of the blood may be found mixed with the fluid (hæmatocele). The cyst is usually single. From this type there are numerous variations: thus, the occurrence of a congenital tumor, consisting of one or two cysts, with a solid basis, is sufficiently common; and the number of the cysts, as well as the quantity of solid matter, may be increased until the whole side of the neck is filled with a solid tumor, in which cysts with various contents are scattered. This latter affection is, I believe, always congenital.[1]

The neck is undoubtedly the favorite situation for congenital tumors, and those which occur congenitally in this region are almost always of the polycystic variety. The question of chief importance in their diagnosis and treatment refers to the proportions of solid substance which they contain. They usually extend deeply into the part, passing underneath the cervical fascia into the loose cellular tissue supporting the carotid sheath, the trachea, and œsophagus, and very often will be found to have completely surrounded one or more of these structures. I have seen cases in which the morbid growth had affected the structure of the tongue as well as the cellular tissue of the neck.

In the front of the neck these congenital tumors appear always to originate in the loose cellular tissue beneath the cervical fascia, and to make their way through that membrane and beneath the skin simply by pressure. I have never seen a case in the front of the neck which did not bear out Mr. T. Smith's assertion,[2] that congenital cystic tumors are always situated beneath the muscular fascia, although many of them have a subcutaneous portion.

The carotid triangle is a favorite situation for these tumors. In one instance under my care, the solid portion of the tumor contained such numerous and variously-shaped cells as to raise a suspicion of malignity.

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[1] See also a case in Path. Soc. Trans., vol. i., p. 256.

[2] Gurlt, Ueber die Cystengeschwülste des Halses, p. 210, says that very few of the recorded cases have been congenital.

[1] See, on the subject of these compound cystic tumors of the neck, a paper by Mr. Cæsar Hawkins, in Med.-Chir. Trans., vol. xxii.; one by the author "On congenital Tumors," Lancet, May 21 and 28, 1864; and see also the section on congenital tumors in the essay on the SURGERY OF CHILDHOOD, p. 865.

[2] In his paper in St. Bartholomew's Hospital Reports, vol. ii.

The diagnosis of the affection has been obvious in all the cases which I have seen.[1] The only ambiguity which I have met with is, as to whether hardening around the base of a cyst depended on the presence of a solid tumor, or was due merely to the pressure of the cyst. The doubt would much influence our prognosis, though perhaps it would not make any difference in the treatment adopted at the commencement. I ought also to mention that Von Ammon[2] describes and figures tumors apparently of this compound cystic nature, as congenital enlargements of the thyroid body. I have not seen any which are developed in that organ. The diagnosis would be easily made by watching the effort of swallowing on the position of the tumor, and by tracing, if possible, the muscles connected with the thyroid cartilage and under border of the hyoid bone.

As to the prognosis and treatment of these cases. The simple hydroceles advance somewhat rapidly; they may grow, however, to a large size without making pressure on the deep-seated organs, and treatment may be adopted with much prospect of success.[3] I have seen in an instance of simple hydrocele a single injection of tincture of iodine followed by complete cure, although the cyst was of large size. The patient was an infant, under Mr. Prescott Hewett's care, and on examining the parts afterwards nothing was to be felt but the hardened remains of the cyst, while the distended skin hung in a loose fold over the clavicle. In other cases, even when some thickening existed at the base of the cyst, I have seen iodine as completely, though less rapidly, successful. But where there is solid matter as well as cysts, iodine injection does not usually succeed, and then it may be justifiable to resort to setons, though the measure is not without danger,[1] or to make a free incision into the cyst or cysts, and endeavor to procure their obliteration by the granulating process, or to cut a large piece of the cyst out, or even to destroy the whole mass by the application of arrows of caustic, as recommended by Maisonneuve (see MINOR SURGERY, p. 665). But in cases which are suitable for removal, extirpation, though of course it presents more immediate risks, seems ultimately the less dangerous course. On this subject the reader is referred to what is said below on the general question of removing tumors of the neck.[2]

Deep sebaceous cysts.—The nature of the tumors which are so often found in the deeper parts of the neck, that is to say, lying in or below the deep cervical fascia, is a matter of great importance in their surgical treatment. Langenbeck[1] has pointed out that dermoid cysts in this region, contrary to what takes place in other parts of the body, are frequently found below the deep fascia, and not unfrequently adhere to the sheath of the cervical vessels, or are possibly developed in the substance of the sheath.[2] As to diagnosis from cysts of a different kind, Langenbeck points out that in all the recorded instances these deep sebaceous cysts have been situated in the neighborhood of the larynx, or of the great vessels of the neck, above the omohyoid muscle; that in the latter situation they are perceptible from the mouth, and the peculiar fluctuation of the pulpy fluid they contain may be felt by placing one finger in the mouth and another on the skin; that the swelling is of a round or oval form, and perfectly smooth; that they may often be made to share the pulsation of the carotid by drawing the head strongly backwards and to the opposite side; and that they are, sometimes at any rate, movable from side to side, but not upwards and downwards. It must, however, be allowed that these signs are hardly sufficient to distinguish them from other cysts in all cases without a puncture. After having tried all the usual plans of treatment, and after having succeeded in curing one of these tumors by maintaining suppuration in it for a year and a half, Langenbeck has found such measures so uncertain and so tedious that he prefers extirpation with all its risks.

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[1] M. Michaux (Bull. de l'Acad. Roy. de Méd. de Belgique, vol. xii., and Gaz. des Hôp., No. 36, 1853, pp. 136, 144, 147) relates several cases of hæmatocele of the neck, in some of which the diagnosis was so obscure that nothing but puncture would clear up the difficulty. In most cases the diagnosis from aneurism may easily be made, even if the tumor should have the arterial pulsation, by remarking that though pressure on the carotid below suspends the pulsation of the tumor, it leaves it equally full, tense, and distinctly fluctuating, as also by studying the bruit. See a case reported by Gurlt, op. cit., p. 225.

[2] Die angebornen chirurgischen Krankheiten, tab. xiii., figs. 1, 2, 3; tab. xxiii., figs. 7 to 11 incl.

[3] A case is reported by Wernher (Die angebornen Cysten-Hygrome, Giessen, 1843, p. 3), where openings formed spontaneously in the tumor, the fluid oozed away, and a natural cure resulted. Another is recorded by Mr. B. Phillips, Med.-Chir. Trans., vol. xxv., p. 299.

[1] Thus, in Dr. Storch's case (Journ. f. Kinderkrankheiten, vol. xxxvii.), the seton was used with a fatal result. The dangers of setons in cases of cysts of the thyroid body are well known. They are perhaps less dangerous in other deep-seated tumors of the neck; but they should never be used without grave deliberation. I have seen the use of a seton in a case of this sort fatal in a week to a person otherwise in good health.

[2] It was in all probability to such tumors as these that Mr. Liston refers in the following passage: "In the lower triangular space of the neck, though not so frequently as in the upper one, all sorts of strange tumors are encountered. Many watery tumors are met with here, some of them in young patients, and congenital; others appearing at a later period. The smaller ones may be opened and dressed from the bottom, or treated with escharotics. Some of them may be punctured and treated by seton; others have besides a mass of solid material attached, and then extirpation, if practicable, is to be preferred. A curious case occurred in my hospital practice lately; a middle-aged healthy man applied on account of a soft elastic lobulated mass, filling completely the space above the right clavicle. It was taken to be a fatty tumor, and was cut upon accordingly. The first incision gave vent to an ounce or more of serum. The dissection was pursued, and six or eight other distinct sacs adherent to each other were gradually exposed and extracted. The space of the neck was completely laid bare, the nerves could be seen, and the subclavian artery pulsated at the bottom of the wound. The internal jugular vein, for two inches, was exposed; and, for the first time, I was cognizant of air rushing into a branch entering into the root of this vessel. So complete was the exposure of parts that the carotid and subclavian arteries could have been tied without further dissection. All went well." Liston, Practical Surgery, 4th ed., p. 330.

The most ordinary of all surgical affections of the neck is the *enlargement of the glands*, which is so very common in scrofulous persons, especially children. On this head reference is to be made to the essay on DISEASES OF THE ABSORBENT SYSTEM; and to Mr. Savory's essay on SCROFULA, Vol. I., p. 170. But I would here call attention to a point of some practical importance, noticed by Prof. Miller.[3] He points out that scrofulous enlargement of these glands "must be carefully distinguished from the syphilitic glandular affection, characterized by implication of the whole chain of lymphatics on both sides of the neck, along the anterior margin of the trapezius . . . . The glands affected (with syphilitic disease) are painless, about the size of hazelnuts, indurated, and never suppurate. They become affected in this manner before any eruptions make their appearance, and continue sometimes long after any other constitutional symptoms." He regards this condition as almost pathognomonic of constitutional syphilis. He also describes another form of glandular enlargement usually on one side of the neck, of a stony hardness, and generally involving the whole lymphatic chain. The hardness closely resembles scirrhus, but has no real connection with the cancerous cachexia. It is due to anæmia, and is sometimes conjoined with exophthalmic goître.

Other glandular affections in the neck are occasionally met with, though less commonly than the above. Thus, in the 16th vol. of the Mémoires de l'Acad. Nat. de Médecine, is a paper by Larrey, Jr., on a form of glandular enlargement from chronic inflammation, which he has often met with among the younger soldiers of the French army, and which he refers neither to syphilis, scrofula, nor local irritation (unless it be excited in some cases by stomatitis, the result of the abuse of tobacco), but rather to the moral and material depressing causes incident to the change from the civil to military life.

A peculiar form of enlargement of the cervical glands is described by Dr. J. W. Ogle, in Path. Soc. Trans., vol. xi., p. 255, in which they formed a chain of large rounded tumors, which were successfully removed by operation. The nature of the affection remains obscure.

These glandular affections also may implicate the sheath of the great vessels of the neck. Thus in Larrey's case, mentioned below, p. 942, and in several of those referred to by Langenbeck, enlarged glands were found in the substance of the sheath itself; and on their removal, the carotid artery or the jugular vein, as the case might be, but more commonly the latter, was left cleanly dissected out, and quite deprived of all covering from its sheath. Langenbeck cautions his readers not to be deceived into relying too much on the mobility of such tumors as a certain mark of their superficial position, since this may really be only the movement of one part of the tumor on another, and the deeper parts of the mass may be lying on, or between, or even behind, the vessels. He does not on that account shrink from advising the removal of such tumors when other means fail; but it is plain how great the dangers and difficulties of the operation may prove. It should, therefore, never be performed unless the glands affected are limited in number, unless the symptoms of the disease are really productive of serious distress, and unless a very patient trial has been given to topical and general remedies; and the surgeon ought to enter on the operation with a full knowledge of the difficulties he may encounter, and the precautions which are to be taken to meet them.

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[1] Archiv f. klin. Chir., vol. i., part 1, Beiträge zur chirurgischen Pathologie der Venen, one of the most interesting and important treatises in the whole range of surgical literature.

[2] The published instances of this disease before the date of Langenbeck's paper will be found in Gurlt, op. cit., chap. vi., cases 3, 5, 6, pp. 266, 267.

[3] System of Surgery, 1864, p. 844.

Cancer also, whether of the epithelial or other forms, may affect the deep parts of the neck and implicate the sheath of the vessels. It may be known by its occurring later in life than the previously-named affections; by its less defined outline; the strings or processes which often project from it; the pain which it produces; its tendency to spread towards the pharynx, thus producing dysphagia and dyspnœa; by the more extensive interference with the circulation which it causes, and in advanced cases by the enlargement of the glands below the tumor. The innocent tumors previously described, though they may compress the vessels, do not infiltrate them; but with these cancerous tumors the vessels and nerves may be absolutely incorporated. If, therefore, they are to be operated on, it should not be without the most careful and repeated examination.

The diagnosis of tumors at the root of the neck, in fact in all parts of the region, but particularly at the root, near the pleura, must be carefully made from the *abscesses* which are so frequent in this situation, and which have been spoken of in the essay on ABSCESS, Vol. I., p. 338. Such abscesses do not fluctuate at first, in consequence of their deep position and their being bound down by the fascia; but they are seldom, if ever, found without some sign of inflammation, besides which the diseases on which they often depend will be present, and will materially assist diagnosis. These are scrofulous affections of the glands, disease of the vertebræ, inflammation of the pleura, and, it is said, disease of the arteries; other abscesses, however, having no visible exciting cause, are not uncommon. The rate of progress of the disease, its much more acute symptoms, and the ill-defined extent of the swelling, usually distinguish abscess from tumor. Hydatid cysts have also been found in this as in most other regions. Mr. Dixon's case is well known;[1] and others, both within the thyroid body and external to it, will be found in Gurlt's work. The proper treatment will be to lay open the cyst, take
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[1] Med.-Chir. Trans., vol. xxxiv.

[1] Op cit., p. 39. A comp
the recorded cases of each
tumor may be found here.

case recorded by Larrey[1] even prolonged to, the sternum by a fistulous channel. The second (the supra-thyroid bursa) is of smaller size, and lies on one side of the middle line, covered by the thyro-hyoid muscle. Both of course follow the larynx in its movements during deglutition, and so far resemble the cysts of the thyroid body; from which, however, there can be but little practical difficulty in distinguishing them. If there be any doubt about the diagnosis, the character of the fluid evacuated by puncture will settle the point. Instead of the disintegrated remains of blood which are found in the thyroid cysts, these contain the jelly-like fluid which characterizes bursal tumors and ganglions in other parts of the body. The treatment should be the same, viz., puncture and blisters, or injection of iodine.

A curious and rare affection in the neck is the *congenital fistula*, originally described by Dzondi and Ascherson,[2] and of which I have given an account in another work.[3] I need merely say here that these fistulæ communicate often with the trachea, and in some there has been reason to believe that a communication existed with the pharynx; that they form one or more minute openings, sometimes in the middle line, at others on both sides and at the same level, or again on one side only (generally the right); their position varying from the level of the notch which marks the upper border of the thyroid cartilage down to the neighborhood of the sterno-clavicular joint. The only case I have seen was amenable to a very simple plastic operation, but here no communication with the trachea or pharynx could be traced. The inconvenience caused by the fistula is so slight that I should not recommend any more radical proceeding. The origin of these fistulæ is referred by Ascherson to the persistence of portions of three fissures which were discovered by Rathke to exist in the neck of the human embryo and those of other warm-blooded animals at an early period of development, analogous to the branchiæ of fishes, and coinciding in the time of their appearance with an arrangement of vessels similar to what exists in fishes.

Removal of tumors of the neck.—Tumors lying below the deep fascia of the neck are always the source of anxiety, and often of great embarrassment, in their removal; and this becomes more and more the case as the tumor passes further forward. When the mass lies beneath the sterno-mastoid muscle, the surgeon must always consider carefully, before he commences the operation, whether he is likely to be able to bring it to a termination—that is to say, whether he has a fair prospect of removing the whole growth; for unless such a prospect exists, the operation is unjustifiable. The main points in these operations are so well detailed in an account by Mr. Spence, of the removal of an enormous enchondroma from the neck and face, that I cannot do better than refer the reader to his most interesting paper in the Dublin Quarterly Journal of Medical Science, Nov., 1863. The operation was, as far as I know, unique at the time, the tumor extending from the zygoma nearly to the clavicle, and from the spine to the cricoid cartilage, and weighing more than 7 lbs. In summing up the chief points of this very remarkable case, Mr. Spence dwells upon the following as the main considerations to decide the practicability of removing a tumor from beneath the sterno-mastoid muscle: 1. Is the growth innocent or malignant? If malignant, the important structures near which it lies will very probably be incorporated with it, and the tumor could perhaps only be removed by doing fatal damage to them: if innocent, however closely it may press on these structures, it will be enclosed in its own capsule; and by keeping the edge of the knife or scissors close upon the tumor, the main vessels and nerves will in all probability be avoided. 2. The state of the circulation: engorgement of the veins on either side,[1] or marked alteration of the arterial supply in the affected side, would give reason to fear that the growth is extensively connected with the internal jugular vein or the carotid artery respectively. And finally, the impairment of the functions of respiration or deglutition, or the existence of laryngeal irritation, would point to implication of the vagus nerve, the phrenic or the laryngeal nerves, or to pressure on the œsophagus or air-tube. Careful exploration from the mouth, and an examination of the mobility of the tumor in various positions of the head should not be neglected.

[Perhaps it is owing to the introduction of anæsthetics, and the consequently less

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[1] Gaz. des Hôp., 1853, pp. 212, 225.

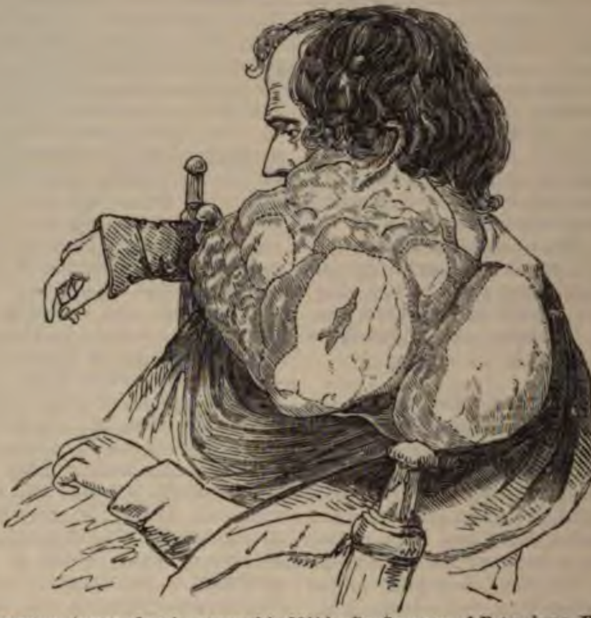
[2] Translated in Dr. Day's Obstetric Records, vol. i.

[3] Surgical Treatment of Children's Diseases, 2d ed., p. 138.

[1] Langenbeck points out that in tumors which involve the sheath of the vessels, engorgement of the veins of the face is rarely absent. In one case he observed this venous engorgement to be on the opposite side to the tumor. This he attributed to the fact that the tumor compressed the carotid artery as well as the jugular vein, as proved by the weakness of the pulse in the temporal artery.

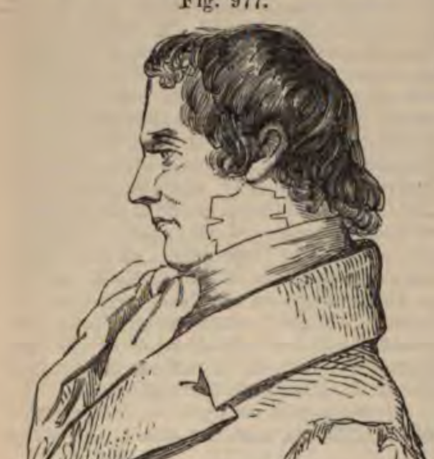
formidable character of surgical operations, and partly also to the fact that the profession at large are better qualified and more ready to deal with tumors in their early stages, that it seems that the enormous growths met with by the older surgeons are far less frequent at the present day. In former times, patients waited until life was no longer endurable before going, perhaps a long distance, to consult some learned professor; and the operation was a truly terrible ordeal to look forward to. Nowadays, the removal of a tumor is shorn of its terrors for the patient, and rendered much easier for the surgeon.

Fig. 976.



Enormous tumor of neck, removed in 1844 by Dr. Spencer, of Petersburg, Va.

Fig. 977.



The same patient after recovery.

As an instance of the courage required on both sides in the pre-anæsthetic period, fig. 976 is introduced, representing a patient operated on in 1844 by Dr. P. C. Spencer, of Petersburg, Va. The details of the case may be found in the Am. Journal of the Med. Sciences for Jan., 1845. Fig. 977 is from a sketch taken after the man's recovery.]

In the operation for removing such tumors, the main points are to have a very free access to the tumor, and for this purpose to dissect large flaps off it by crucial incisions, to define its surface clearly and for a large extent in some position where its relations are free from danger (usually its posterior border), and to work gradually from this point by stretching the tumor so as to make plain its cellular connections, and then cautiously dividing the latter with the scalpel or blunt-pointed scissors directed *toward* the tumor.[1] In Mr. Spence's case the extent of the growth was so great that the whole sterno-mastoid was of necessity divided; and then the plan which Mr. Spence adopted, of exposing the whole front of the tumor and cutting across the muscle at once, is no doubt the best, since it gives as full a view as possible of the whole neck, and enables the assistant (whose duties in these operations are almost as important as those of the operator) to compress the main vessels, and to push them back, by insinuating his fingers in the track of the dissection. But in the case of a tumor situated beneath the sterno-mastoid, of much less extent than in Mr. Spence's patient, although still of considerable size (since the dissection commenced above, over the mastoid process, and terminated below by exposing a part of the brachial plexus, and was continued backwards to the transverse processes of the cervical vertebræ), I was able to remove the tumor without cutting through the whole sterno-mastoid;[1] and I believe that it is better to retain the sternal portion of the muscle entire, if possible, whenever the growth does not project beyond its anterior edge. This proceeding is more dangerous than that adopted by Mr. Spence, since the part of the growth lying near the carotid sheath has to be dug out, as it were, from beneath the muscle almost in the dark; but, on the other hand, the preservation of a part of the muscle is a safeguard against deformity. When the edge of the tumor has been fairly and cleanly exposed, the operator should next endeavor to clear its lower part, whenever there is a doubt as to its relations to the great vessels of the neck, in order to expose their sheath, and render himself master of the circulation through them. Cases quoted below will show that both the common carotid artery and internal jugular vein may be tied without compromising the success of the operation; and even the division of the pneumo-gastric nerve also has been followed by recovery. But every possible effort should be made to remove the tumor without dividing any of these structures, particularly the last. The vein is the most likely to be implicated. Innocent tumors, even when they occupy the sheath of the artery, do not generally surround it. Langenbeck has shown that the jugular vein may be dissected out for some inches from the substance of a tumor, the vessel being entirely denuded and its whole sheath removed, yet no ill consequences follow.[1] If the descendens noni nerve be in the way, as in Gibson's case, it may be divided. In the more delicate part of the dissection blunt-pointed scissors should be used, and the fingers should be employed to sever the adhesions of the tumor as much as possible, and as a guide or director to the cutting instrument when the wound is too deep to allow of a clear sight of the parts. Compression of the internal jugular below the tumor will be a safeguard against death from the entrance of air into the heart.

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[1] Dieffenbach (Op. Chir., vol. ii., p. 327 et seq.) recommends, in operations on large tumors, to use two separate incisions, both

Such operations as these appear to have been rarely undertaken,[2] Mr. Spence's researches having only discovered four published cases of the kind by British surgeons[3] previous to the publication of his own; but smaller tumors, mostly of an enchondromatous or solid fibrous nature lying in the anterior triangle of the neck, or over the parotid gland, are very common, and the operations for their removal must be managed on the same general principles, viz., to open the capsule of the tumor (when it has one), expose its surface freely in some safe part, and then stretch and carefully sever the cellular adhesions of the other parts. In doing this the operator must take all possible precautions not to permit

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longitudinal, one running over the front of the tumor, more or less parallel to the anterior edge of the sterno-mastoid, the other behind that muscle. He used to dissect the tumor free from its spinal attachments from the posterior incision, and to free it from the vessels, etc., by dissecting from the anterior one. His main object seems to have been to avoid the division of the sterno-mastoid; but a sufficient number of cases are now on record to prove that even the entire section of this muscle does not do any material harm.

[1] Lancet, 1864, vol. i., p. 567.

[1] Archiv f. klin. Chir., i., 4, 14.

[2] Some surgeons are indeed formally opposed to such endeavors. Thus Professor Miller says that "tumors beneath the sterno-mastoid do not admit of operative interference." A System of Surgery, 1864, p. 846.

[3] Mr. Atkinson, of York, relates, in the Med. and Phys. Journ., vol. xxx., p. 353, a case, the physiognomy of which, as given in the drawing, is something like that of Mr. Spence; but the account is obscure, and it is not said whether the tumor lay above or below the sterno-mastoid. This tumor weighed 3 lbs. 9 ozs., and the carotid artery and jugular vein were exposed in its removal. The operation was successful. Mr. George Bell has also put on record, in the Journal of Medical Sciences (Edinburgh, vol. i., 1826, p. 61), an operation for the removal of a tumor weighing about 4 lbs. "from the muscular fascia of the neck." This tumor lay above the sterno-mastoid, but dipped down, so that the common carotid artery was exposed in removing it. It stretched from the mastoid process to the clavicle, and seems to have been of a malignant nature, as it recurred a few months afterwards.

TABLE OF THE CHIEF FORMS OF TUMOR IN THE NECK.

	Origin and Progress.	Relations to neighboring parts.	Movements communicated from neighboring parts.	Fluctuation.	Remarks.
Abscess.	Recent origin. Quick progress.	Soon affecting the skin.	No.	Yes.	
" below the fascia.	Do.	Rapidly producing great pressure on the pharynx.	No.	Possibly not perceptible.	Known by the inflammatory œdema of the skin.
Simple hydrocele.	Sometimes congenital. Gradual growth.	Usually superficial; in some cases displaces or laps round the sterno-mastoid.	No.	Yes.	May often be known by its complete transparency.
Compound cystic tumors.	Always congenital. Growth often rapid.	Spread variously, and often very extensively.	No.	In parts.	Fluid resembling blood, or variously blood-tinged, often evacuated on puncture.
Bursal tumors.	Remote origin and slow growth, generally.	Limited to the three situations pointed out on p. 936.	Moves with the larynx.	Yes.	A rare but very trivial affection; the diagnosis obvious in the few cases I have seen.
Simple sebaceous tumors.	Not congenital. Slow growth.	Superficial.	No.	Not usually, only when the fluid is thin and the cyst not tense.	
Deep sebaceous cysts	As above.	Lying in the carotid triangle, pressing on the great vessels, and perceptible from the mouth.	No.	Imperfect fluctuation may sometimes be felt from the mouth.	Can often be made to share the pulsation of the carotid in proper positions of the head (v. p. 935).
Glandular tumors.	Connected with the development of other diseases. Growth variable; usually multiple.	Very various; generally forming a superficial chain down the neck.	No.	Only when suppurating.	Usually in strumous persons, with eruptions of the scalp, carious teeth, etc.; or (when affecting the posterior chain) in constitutional syphilis.

TABLE—*continued.*

	Origin and Progress.	Relations to neighboring parts.	Movements communicated from neighboring parts.	Fluctuation.	Remarks.
Other innocent tumors.	Noncongenital. Growth usually slow.	Very variable; seldom make pressure on the deep structures, unless of long growth, and never infiltrate them.	No.	No.	They are known from enlarged glands by their solitariness and the absence of remote affections; from malignant tumors by their slow growth and by their limitation.
Cancerous tumors.	Not congenital. Growth usually rapid.	Liable to spread rapidly and deeply; enclosing the great vessels, and pressing on the trachea, pharynx, etc.	No.	No; or only in small portions.	Known by their rapid diffusion and absence of distinct limitation, together with the usual symptoms of cancer; the cachexia often marked.
Enlargement of thyroid.	Often in females; originating about puberty. Growth generally slow and limited.	Lobulated swelling confined to the situation of the gland or one of its lobes; very seldom compressing the trachea, and hardly ever the great vessels.	Moves very freely with the action of deglutition.	Often contains large cysts.	Diagnosis generally quite easy. May pulsate, or be accompanied by protrusion of the eyeballs and heart-affection.
Induration of sterno-mastoid.	Usually congenital. Slow, or no increase.	Limited to the course of the fibres of the muscle.	Shares the movements of the muscle.	No.	

the entrance of air into the veins, and all large veins should be tied before they are cut.

Foreign surgeons have been somewhat more bold in their treatment of these formidable tumors. Langenbeck's brilliant operations have been referred to; and his paper should be studied by every surgeon entering on this department of operative practice. In connection with this question the reader may also be referred to the paper by Larrey in the 16th volume of the Memoirs of the French Academy of Medicine, in which the propriety and the method of performing these operations are discussed at length. M. Larrey regards such operations as being the most uniformly successful in the whole range of surgical practice, if only the risks of the operation itself are got over without disaster.[1] Several interesting cases are quoted, especially one in which his father, the first Baron Larrey, removed a mass of diseased glands from the anterior triangle, one of which was embedded in the sheath of the vessels; and another case in which M. Labat successfully extirpated a tumor extending from the mastoid process to the clavicle, and lying altogether beneath the sterno-mastoid muscle, which was divided across in order to expose it. The carotid artery and internal jugular vein had to be tied, and the pneumo-gastric nerve divided.[2]

The Axilla.

There are a few particulars with reference to *abscess* in the axilla to which it may perhaps be worth while to give a little attention. Superficial abscesses, indeed, have no characters in this region to distinguish them from those of other parts of the body; but deep abscesses, *i. e.*, those situated in the cavity of the axilla, internal to its walls, often constitute a grave malady. Cases are on record where such abscesses have burrowed beneath the muscular walls, into the neck, the back, and even the thoracic cavity. Their causes are various. Some depend on simple sprains or contusions, or occur without visible cause; others on lymphatic inflammation; others on caries of the bones of the thorax or of the shoulder; or even, it is said, on empyema or vomica.[1] The symptoms of the spontaneous abscess will usually be more acute than those of the symptomatic; but the only reliable diagnostic sign is a thorough examination by means of the probe, under chloroform [or ether] if possible.

It is of great importance in acute abscess of the axilla to procure a ready and free escape for the pus; since if the opening is small, and the abscess is allowed to get into a chronic condition, it is very liable to fall into the condition of a sinus, which is then kept from healing by the action of the muscles. Therefore, if the abscess is seen before opening, a free and large incision should be made, care being taken to keep the edge of the knife towards the thorax, in order to avoid the large branches of the axillary vessels and nerves which lie towards the humerus. If the abscess be in a chronic condition, and no evidence of diseased bone be detected, the treatment is not easy. If the arm be kept at perfect rest, and the patient be well nourished and fattened, the abscess is most likely to fill up, but it will be at the risk of some loss of motion from cicatrization and adhesion. This seems, on the whole, the best course; for laying open the whole cavity may do more harm than it is meant to obviate. Sinuses must be treated in the usual manner by stimulating injections, setons, or drainage-tubes, with rest. If adhesions or cicatrices have formed, their subcutaneous division will be indicated; and should much skin have perished, it may be thought right to free the cicatrix from the sound skin in its whole extent, and cover it with a transplanted flap.

Tumors occupying the axillary space, like those developed in other situations where large loose areolar intervals exist, are liable to grow to a very large size before they produce so much distress as to oblige the patient to request relief from a surgeon. In examining such a tumor two main questions present themselves: first, whether it is innocent or malignant; second, whether, if innocent, its relations are such as to permit of its removal. It is true that even in the case of a tumor judged to be malignant, if it could be very clearly separated from the periosteum of the humerus, it might be proposed to exercise it; but in most cases of cancer, amputation would be the preferable course, if any operation were admissible. Nothing need be said here about the diagnosis of innocent from malignant disease, this being the same in the axilla as in other parts. We pass on to the question of the relations of the tumor. Superficial tumors are decidedly rare in this region. Notwithstanding the hairy condition of the integument, sebaceous tumors are hardly ever met with. I do not remember to have ever seen one removed from the axilla. The tumors which lie below or in the fascia are of course less movable than those in the subcutaneous areolar tissue. If the mobility be extremely limited, this may be due either to their attachment to the bone, or to their being connected with the sheath of the vessels; the former tumors will be almost immovable, and there will probably be no interference with the circulation; the latter will enjoy somewhat more movement, and the circulation will be more or less impeded. If the venous congestion and œdema be well marked, while the pulse is unaffected, there is direct evidence of pressure on the vein; while if the pulse be also weakened, the tumor probably envelops and compresses both vessels. Its relations to the nerves will generally be determined by the occurrence of twitching, "pins and needles," or numbness. Tumors adherent, even over a great extent, to the sheath of the axillary vessels, may be removed with success by a daring operator, as Langenbeck's experience shows; and even if it were necessary to tie both of the vessels, it would be better to run that risk than to sacrifice the arm; but when the nerves are also involved, the case becomes almost desperate, especially as the most important of the nerves—the median—will be in all probability the most deeply implicated.

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[1] Dieffenbach also says: "Eine grosse Anzahl Operationen dieser Art, welche ich gemacht habe, sind in keinem einzigen Falle von einem tödtlichen Ausgange begleitet gewesen, und die Heilung erfolgte gewöhnlich ungemein rasch.' Op. Chir., ii., 322.

[2] In Gibson's case (Am. Journ. Med. Sci., vol. xiii., p. 305) the tumor was successfully removed from beneath the sterno-mastoid after the carotid artery and jugular vein had been tied and divided. The descendens noni nerve was cut, but the pneumogastric was dissected out of the mass. The disease was malignant, and recurred; yet it was enveloped by a very firm and distinct capsule.

[1] Nélaton, Path. chir., vol. v., p. 875.

Exostoses and other tumors springing from the upper end of the humerus may project into the axilla, and may come into more or less close relation with the vessels and nerves. Thus in the case of a lad under my care at St. George's Hospital, a large exostosis, lapping round a great part of the humerus, raised up the artery for a considerable extent. But there is little risk of injury to the main vessels in operating on these cases, since the muscles which separate the bone from the artery can hardly have been atrophied, unless the tumor has attained most unusual proportions. The greater danger is to the circumflex or musculo-spiral nerve, as the case may be. In my case the tumor was so extensive as to trench closely on the position of both of them; but as there were no symptoms of pressure on either, I felt confident that it might be removed without injury; as turned out to be the case. Softer tumors implicating the periosteum of the humerus are always to be looked on with suspicion, since many of them are malignant. But if any doubt exists on this point, the minor operation of excision of the tumor and head of the bone should, no doubt, be resorted to. Sir W. Fergusson, in his recent lectures at the College of Surgeons, gave two cases in contrast with each other strikingly illustrative of the advantages of the course recommended.[1] In one, which was under Mr. Syme's care, that surgeon removed the head of the humerus with the tumor in 1860. A year afterwards, the disease recurred in the scapula; and in November, 1862, the scapula and a portion of the clavicle were removed with perfect success, leaving the patient with a useful arm.[2] In the other case, the arm had been amputated at the shoulder-joint before the patient came under Sir W. Fergusson's care, who was obliged, by the recurrence of the disease, to remove the scapula. A case under Mr. Hutchinson's care[3] shows that, even in malignant tumor of the humerus, its removal by the operation of excision may be followed by the union of the wound, but does not give much encouragement for the practice, since the patient's life does not seem to have been prolonged by it. It is right, however, to add that the operation was performed by Mr. Hutchinson only after amputation had been refused by the patient.

The removal of *enlarged glands* from the axilla is generally a very simple matter when performed, as it usually is, as part of the operation for scirrhus of the breast; since the glands affected lie near the pectoral muscle, away from the large vessels. The extirpation of strumous glands is a measure of doubtful prudence;[4] and yet if there is no other indication of the strumous cachexia, and the tumor is productive of much inconvenience, such operations are sometimes undertaken. I once performed such an operation on a child, and ascertained that the patient remained in good health and free from any other manifestation of struma for at least a year, after which time I lost sight of her. An operation of a similar kind is reported in the Lancet, 1850, vol. ii., p. 22, as having been performed by Sir W. Lawrence. But if the surgeon determine on this proceeding, he must not deceive himself as to its probable difficulties and dangers. In loose cellular spaces, as the axilla and the neck, besides the glands which are perceptible before the operation, there are sure to be others more deeply situated, which are only perceived after the removal of the first. This has been the case in all such operations as I have witnessed. It was so in the instance referred to under Sir W. Lawrence's care, as well as in my own case, and in two such operations which I have witnessed in the neck. In my case the axillary artery was wounded—I believe inevitably. In one of the cases in the neck to which I refer a considerable mass of disease was left behind. In Sir W. Lawrence's case the difficulties and embarrassments seem to have been great, and would have been very disagreeable anywhere except in hospital practice, where plentiful resources and assistants are always at hand. Again, in most of these cases (as in three of the above four) the glands have been found to be in a state of suppuration; and it must remain doubtful whether nature would not have accomplished the removal of the strumous tubercle in this way as completely as the surgeon. Therefore such measures should only be resorted to after the most mature consideration; and everything should be at hand which is necessary for a prolonged and difficult dissection among large vessels and nerves.

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[1] Lectures on the Progress of Anatomy and Surgery, pp. 46–49.

[2] Syme on Excision of the Scapula, 1864, p. 22.

[3] Path. Soc. Trans., vol. viii., p. 346.

[4] See the essay on SCROFULA, Vol. I., p. 171.

Langenbeck, in the paper above referred to (page 935), has dwelt upon the frequency with which the tumors, glandular and others, developed in the axilla are found attached to the sheath of the large vessels, and on the best means for extirpating them. That innocent tumors may be removed with success, whatever be their size and however extensive their connections, is proved by the case related by Langenbeck,[1] in which he removed a portion of the clavicle affected by a tumor dipping deeply in between the jugular and subclavian veins, and affecting the scalenus anticus muscle, which had to be divided.

Langenbeck recommends that the anterior surface of the tumor be freely exposed, the muscles being divided as far as may be necessary. In one of his successful cases, both pectoral muscles, the deltoid, and a portion of the coraco-brachialis were divided. The tumor is then to be exposed by a free division of its capsule, and the vessels are to be sought for above, where they enter into the tumor. This course he prefers to the opposite plan of exposing the artery and vein at the lower part, for similar reasons as in the neck (see page 939). The sheath of the vessels, infiltrated by the disease, must be carefully divided and stripped from the vessels, which should only be tied in the last resort. If the great nerves be implicated in the tumor, so that they cannot be cleared away from it, amputation will become necessary. I recommend a very careful study of Langenbeck's cases to any one who intends to perform one of these operations. A good idea of the probable relations of the tumor will be found by noticing the presence or absence of pricking sensations down the course of the nerves, or loss of their functions, of œdema and venous engorgement, and of alteration of the pulse. In cartilaginous or hard fibrous tumors, processes may project, deep in the axilla, among the vessels and nerves, or may run under the clavicle and approach the subclavian vessels and the pleura, and much add to the embarrassments and dangers of the proceeding. This is still more the case when the tumor originating in the neck has passed down into the axilla, as in Langenbeck's case, referred to above, in which the pleura seems to have been freely exposed, though not opened; and the patient afterwards died of pleurisy. However, in a case of a large fatty tumor of the root of the neck, which was under my care some years since, at the Hospital for Sick Children, and which sent a process down into the axilla, the removal was easily and safely effected from the main wound in the neck. A drainage-tube was passed through the cavity in the axilla, and out below the edge of the pectoralis major. The child recovered without any deformity or bad symptom.[1]

In cases of tumors which implicate the axillary vessels, the vein is often the one which is most firmly attached to the tumor. This is a consequence partly of its position, and partly of its being (like all veins) more readily affected by pressure. Consequently there is more risk of wounding the vein than the artery in such operations. In case of wound of the vein, the late Mr. Moore recommended that the artery should be secured as well as the wounded vein, and he used to refer to a case in which he had adopted this practice successfully. He believed, on the authority of this case, as well as of some of the others quoted above in which the main artery and vein have been tied in the removal of cervical and other tumors, that phlebitis is less likely to follow, and that the risk of gangrene is not increased, by the ligature of the artery. I may add, that when in such operations the brachial plexus is also injured, the limb should be removed at once. I had occasion some time since to regret not having followed this course. In an attempt

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[1] I mean with success so far that no fatal injury was done to the parts. The patient died of the after consequences of the operation.

[1] Surgical Treatment of Children's Diseases, 2d ed., p. 371.

TABLE OF THE CHIEF SURGICAL AFFECTIONS OF THE AXILLA.

	Origin and Progress.	Fluctuation.	Bruit.	Pulsation.	Accompanying Symptoms.
Enlarged glands	In connection usually with disease of the parts from which the lymphatics come. Progress slow.	No.	No.	No.	When not associated with disease of the lymphatics, one of the usual constitutional affections will be present.
Abscess of glands	Origin as above. Progress rapid, and skin soon implicated.	Yes.	No.	No.	
Subpectoral abscess	Often from injury. Progress rapid.	Not always perceptible.	No.	No.	In cases of doubt an exploratory puncture clears up the diagnosis.
Cysts	Origin remote. Progress slow, or none.	Yes.	No; or only a "thud."	No; or only communicated from the artery.	
Aneurism	Originating often in accident. A defined tumor, growing more or less rapidly.	Variable.	Yes.	Yes.	The pulse in the affected and sound arm will probably differ.
Ruptured artery	Originating in accident. An ill-defined swelling; often hardly increasing at all.	Probably.	Yes.	Very probably not, or very obscure.	See the observations on p. 401 of Vol. II.
Innocent tumors	Origin remote. Progress slow.	No.	No.	No.	The various effects of pressure on the vessels or nerves may be present, and should be carefully noted before proceeding to remove the tumor.
Cancer	Origin less remote. Progress rapid.	No.	No.	No.	The vessels and nerves are far more likely to be surrounded by the tumor, or even infiltrated with cancer.

to extirpate an extensive recurrent cancer from the axilla, I was obliged to secure both vessels. The parts were very much matted, thickened, and difficult to distinguish. The patient died of gangrene, and on post-mortem examination a portion of the median nerve was found to have been embraced in one of the ligatures.

The Thorax.

The diseases of the thoracic viscera being the exclusive province of the physician, and their injuries having been treated of in our first volume together with the surgical operations practised upon the pleura, no observations on the regional surgery of the thorax are required here, except a few lines on the subject of abscesses in the thoracic parietes. Such abscesses may arise spontaneously as the result of acute or chronic inflammation, or may be symptomatic of disease of the bones. Diffuse inflammation is the most common cause of the first kind of abscess. It is a serious affection, being often productive of much distress by its local action, as well as testifying to the existence of a grave constitutional malady. Nélaton[1] speaks of a case in which the dyspnœa was so great as to lead to the erroneous diagnosis of visceral inflammation; an error the more likely to be committed since the inflamed condition of the integuments forbids physical examination. Besides, visceral inflammation may ensue: for the inflammation tends to spread inward, and if unchecked leads to the formation of abscesses which may extend beyond the walls of the thorax, and make their way into its interior. Active treatment is therefore necessary. If the case is seen before abscess is formed, free incisions must be made, and the other means adopted which have been prescribed in the essay on ERYSIPELAS for the treatment of diffuse cellular inflammation. If abscess have already formed, it must be opened without delay. The constitutional treatment must be guided by the general symptoms, and by the presence or absence of pleuritic complication—a fact which can only be inferred from the symptoms, if the condition of the parietes forbids direct examination.

Chronic abscess of the chest, unconnected with diseases of the bones, appears generally to take place in strumous subjects, and often in those who are suffering from or predisposed to phthisis. The treatment is the same as in other cases of strumous abscess. Many of those cases which are described in books as abscess pushing the pleura inward, thickening it, and encroaching on the cavity of the chest, may very likely have been cases of limited empyema; at any rate they could hardly be distinguished from the latter except by the history, often an obscure guide in a chronic complaint. The treatment would consist in laying them open; and if this does not suffice, in providing a counter-opening, and keeping them empty by means of a drainage tube. In some cases of empyema much benefit has seemed to be derived from a counter-opening, and the injection of iodine; and the same benefit might be more confidently expected in chronic abscess not connected with the pleural cavity, without the dangers which must be allowed to accompany the iodine injection in empyema.[1] It is not, however, always easy to know whether a small opening may not exist into the pleura, or even into the tissue of the lung. An open abscess, whose wall is in contact with the pleura, will follow its movements. Hence in inspiration its wall will be drawn inward, and its cavity filled with air, which will be ejected in forced expiration.

Most abscesses, however, in the walls of the thorax are symptomatic of disease of the ribs or sternum. The disease is generally caries, though necrosis is sometimes met with; and in some cases, at any rate, it is clearly traced to an injury—usually fracture of the sternum, or separation of its first joint. Thus Nélaton (loc. cit.) quotes from J. L. Petit and from Stalpart Van der Wiel cases in which after gunshot contusion, and after a sword thrust, abscess formed on both surfaces (as it seems) of the sternum, and in which, after cutting down on the front of that bone, the surgeon perforated it with the trephine, and evacuated the matter from the anterior mediastinum. But what the indications for this proceeding were, the accounts appear too meagre to inform us. When, as is more usual, the abscess proceeds from caries of the rib, it appears better not to be too active. The partial resections of the ribs which are spoken of in foreign works on surgery, and which have been chiefly practised in Germany, do not seem very promising operations, while they are by no means free from difficulty and danger. The indications for attempting the removal of a portion of carious rib would be, if it were evidently setting up pleuritic irritation, or if it concealed and shielded a sequestrum on the inside of the bone, which could not otherwise be extracted. In accident, the indications for excision are, if the fractured portion conceals a wounded vessel or traumatic aneurism. If the whole depth of the bone be not diseased, the surgeon would of course desire to avoid wounding the intercostal artery, the bleeding from which is often troublesome. In such cases it would be sufficient to detach the muscles from the upper border of the bone, and carefully chisel away the diseased portion. But if the entire thickness of the bone is to be removed, a small incision must first be carefully made through the muscular parietes, and extended on the director as far as may be necessary to separate the muscles from both edges of the rib to the whole length which it is proposed to remove. Then the internal surface of the bone must be freed from the pleura with the handle of the knife, or some more appropriate flat smooth instrument, and the section made with a Hey's saw.[1]

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[1] Path. chir., vol. iii., p. 497.

[1] In one case at the Hospital for Sick Children, iodine injection had been used several times with benefit, when suddenly one day the child coughed up a quantity of the injection. This was followed by very severe bronchitis. The same accident happened to a child under my care at St. George's Hospital, but was not followed by any alarming symptoms.

Nélaton describes, after Boyer, an operation for the removal of diseased parts of the sternum, in order to evacuate matter confined in the mediastinum, and to remove the source of such suppuration. This has the distinction of being one of the most ancient surgical operations, and was performed by Galen. If a surgeon had made up his mind to make trial of the operation, he would need no very precise directions for its performance; as it consists merely in exposing very freely the surface of the bone, and applying the trephine on all the part which appears diseased; but it seems a doubtful and very hazardous measure, and could only be justified by the presence of severe dyspnœa, for which no cause, except the disease of the sternum, could be discovered. In Heyfelder's work (p. 308) will be found a notice of twelve cases in which this operation has been performed in modern times, and only one of which is said to have died from the operation. But real evidence of success seems wanting in the majority of these cases.

The Abdomen.

Very little of importance has been left for our consideration in this place as to the regional surgery of the abdomen, except abdominal tumors, since its injuries and the surgical diseases of all the viscera, digestive, urinary, and generative, have been described in separate essays. The first consideration in determining on the surgical treatment of a tumor of the abdomen, is whether it lies above or below the muscular expansion. It is possible that tumors may also form between the muscles, but the circumstance does not seem to have been put on record. Superficial tumors of the abdomen are usually fatty. Their superficial situation is recognized by the ease with which they move on the deeper parts, and by their being unaffected by the action of the muscles: the usual dimpling of the skin when pinched up over them, and their lobulated exterior, proves their fatty nature. The only caution which can be required in their removal is to remember that occasionally fatty tumors in the middle line of the abdomen have been found to perforate the abdominal parietes; and, although apparently superficial, to spring from a root in the subperitoneal fat. Such tumors are called by French writers "hernies graisseuses."[1] Their connection with the peritoneum varies in different cases. The greater part, and usually the whole, of the tumor is formed by the subperitoneal fat merely; but in some cases a small process of peritoneum has been found in the centre of the mass, having apparently been pulled down by the traction of the tumor. At other times cysts have been found in the fat unconnected with the peritoneum. Usually these small tumors require no treatment; but several cases are reported in which symptoms of colic or of peritonitis have existed, which have been thought to have depended on the traction of the tumor, and which at least have subsided on the removal of the latter. When such symptoms are present, there would often be a good deal of difficulty in distinguishing the case from one of strangulated hernia. In cases of doubt, it is justifiable to cut down and examine the swelling, taking care to unroll the mass of fat before cutting it away, for fear of wounding one of these peritoneal pouches; but M. Nélaton gives the caution not to be in too great a hurry to operate on these tumors; and this advice coincides with that given by Mr. Birkett, essay on HERNIA, Vol. II., p. 711, in all cases of umbilical hernia, where the symptoms do not very plainly indicate strangulation.

Other superficial tumors, whether innocent or malignant, differ in no respect in this region from their usual characters in other parts of the body. A word of caution may be given as to diagnosis. Most surgeons must have seen psoas abscesses mistaken for tumors of the abdomen—a mistake not very creditable to the care of the person who makes it, since it shows that he has neglected to enquire into the history and symptoms of the case; but easy enough to commit on a mere cursory inspection of the part.

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[1] As to the statistics of this operation, Heyfelder says that out of thirty-seven cases of which he has accurate accounts, eight died; the rest recovered, and very speedily too. Operationslehre und Statistik der Resectionen, 1861, p. 303.

[1] Nélaton, Path. Chir., vol. iv., p. 394.

The deep tumors of the abdomen, which lie beneath the muscles, are next to be distinguished into loose tumors, tumors of the bones, and tumors of the viscera or peritoneum. Of the loose tumors, some lie in the subperitoneal cellular tissue. Among these I would especially call attention to a tumor of the iliac fossa described by M. Nélaton,[1] and of which an instance occurred under my own care.[2] It is a firm rounded tumor lying in the venter of the ilium, moving with tolerable freedom under the muscular wall of the belly, and with a stalk which can be distinctly traced to the inner surface of the ilium, near the anterior superior spine. M. Nélaton has seen more than fifteen cases; and it is a singular circumstance that all his patients were women who had borne children. This was so in my case also. He had operated twice with success, although in one instance he had been unable to avoid opening the peritoneal cavity. The tumor is of the fibrous or fibroid variety, and certainly bears to the naked eye a strong resemblance to the recurrent fibroid; but it did not recur in either of M. Nélaton's cases, and in mine, for more than a year, during which I saw the patient from time to time, there was no sign of renewed growth. In removing such tumors great care must be taken to avoid the peritoneum, if possible; and it is well to be contented with as small an incision as will suffice to expose the whole tumor; since ventral hernia will most likely ensue, and the patient's comfort demands that the hernia should be as small as possible.

The singular peculiarities of this tumor in having always a pedicle from the crest of the ilium, and in occurring always in the same form, and always, as far as present experience goes, in women who have had children, appeared to deserve a special notice for it; but fibrous and other tumors may of course be found in other parts of the subperitoneal space. To all such tumors the same observation will apply, that the surgeon should wait a while and be in no hurry to extirpate them, unless the fact of steady growth is well ascertained; and that in doing so he must take every precaution both to avoid danger from a wound of the peritoneum, if possible, and to guard himself from undeserved blame, should the tumor adhere so firmly to the membrane that its avoidance is impossible.

Malignant tumors, forming below the abdominal wall, will soon become fixed, from implication either of the viscera or the muscles; and thus the diagnosis will in all probability be correctly made during the interval of expectation above recommended in the treatment of deep-seated tumors which appear innocent.

Tumors which enjoy a wide range of motion are met with now and then in the abdomen, and are believed to be in many cases floating kidneys: but many of these tumors have had a range of motion far beyond what the kidney can possibly obtain.[1] In such a case as I once heard of from a friend, where a lump in the belly could be moved from a little below the liver in a curved direction down into the iliac fossa and thence over towards the middle line, always maintaining the same limits, the loose body must have been either a foreign substance in the intestines, which was unlikely in that case from the direction and range of its motion, or more probably one of those concretions in the peritoneal sac so well described by Dr. J. W. Ogle and others.[2] The limits to the range of motion of such a substance might easily have been fixed by accidental adhesions. The point is one of not much practical importance, since in hardly any circumstances would the idea of cutting down on such a substance be entertained; yet if it seemed to be setting up peritoneal irritation, such a proceeding might not be wholly unjustifiable.

The tumors of the bones are generally malignant, though enchondromatous and other innocent formations may occur. They are found in the iliac fossa, or in the pelvis, by examination from the rectum or vagina, or lying on the spinal column. They are recognized by their fixed condition, and by the broad base which always connects them to the bone. They frequently compress, and often implicate, the great veins, giving rise to œdema and venous congestion in the parts below. Some of the more malignant of these tumors pulsate, and thus simulate aneurism. The diagnosis has been spoken of in the essay on ANEURISM. The tumors which affect the spine, if they are large enough to be perceptible externally and to give rise to symptoms, are almost always malignant, and may sometimes be distinguished also by examination from the loins. The small exostoses, so common in old age on the front of the column, do not usually give rise to symptoms, and could hardly be felt from the outside of the body. None of this class of tumors is susceptible of treatment.

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[1] Gaz. des Hôp., Feb. 18, 1862.

[2] Path. Soc. Trans., vol. xv. In the operation the peritoneum was not opened, and the patient recovered.

[1] Rokitansky says, "The occasional movability of the kidney is owing to insufficient fixation by means of the adipose fascia, and apparently also to an elongation of the vessels: we sometimes find that the kidneys can be moved from one to two inches along the spinal column." Path. Anat., vol. ii., p. 188, Syd. Soc. Trans.

[2] Path. Soc. Trans., vol. vi., pp. 204, 208. Vol. viii., p. 212: in this case the loose body was larger than a billiard-ball. Vol. xii., p. 89: here the loose body was felt in a hernial sac before operation. Other specimens will be found described in the same Transactions.

Tumors of the viscera of the abdomen constitute such a very large class, and are so very complicated in their diagnostic signs, that no sufficient exposition of the subject can be attempted here. They affect the liver, the omentum, the spleen, kidney or intestine, the general surface of the peritoneum, the bladder, and in the female the uterus, ovary, or broad ligament. Nothing need be said here about the tumors of the intestines, or of the female generative organs, or of the urinary organs, since these have been treated of in the essays on those subjects.

Tumors of the liver are recognized by their position, by their comparative immobility, and by their being situated in an area beyond which the liver can be recognized as extending (either by touch or percussion), or at least by the liver's dullness extending quite up to them; and when situated on the edge of the organ by their raising the false ribs. Such tumors as are merely attached to the liver[1] will be more movable; but it would be difficult during life to recognize these as hepatic.

The tumors of the liver met with in surgical practice are either cystic or malignant. Sir B. Brodie has described, in his Lectures on Pathology and Surgery, some cases of watery cyst of the liver, in which no proof was given of the presence of hydatid animalcules, and in which a cure was effected by simple puncture with a trocar; in two cases without any symptoms, in another after severe inflammation, and the bursting of an abscess into the intestine, followed by the discharge of a membranous bag, which, however, Sir B. Brodie did not regard as a hydatid.[2]

Large hydatid cysts are accompanied by considerable enlargement, the tumor being rounded and smooth, fluctuating, but less distinctly than the watery cyst, and with a peculiar vibration, due to the presence of the semi-solid bags in the fluid.[1] The smaller hydatid tumors, which are not perceptible externally, will not give rise to any symptoms. After some time ulceration may be expected to take place, by which the hydatids are transferred to some of the neighboring viscera, or the sac suppurates and an abscess forms, which may burst internally or externally. In the latter event, the patient may survive; the others are almost inevitably fatal. Space would fail us to pursue the history of the disease if left to itself; our only object here is with its diagnosis and surgical treatment. The diagnosis of hydatid cysts is to be made from (1) an enlarged gall-bladder, (2) abscess, and (3) cancer. Other ambiguities may occur; *e. g.*, when the cyst rises into the thorax it may be confounded with pleuritic effusion; when it lies in the central part of the abdomen, with aortic aneurism, and other similar difficulties may be met with, but these are rare. It will suffice here to point out the ordinary diagnostic signs. In the first place, then, hydatids grow without any feverish or hepatic symptoms, which is a strong point in their diagnosis from abscess of the liver, and from enlarged gall-bladder. Otherwise the resemblance of some hydatid cysts to an enlarged gall-bladder is very striking; and it would be almost impossible to tell the difference by manual examination merely, as a reference to Frerich's plate, mentioned in the note, will show. Next, the smooth round surface of the hydatid swelling usually distinguishes it from the more lobulated mass formed by a large cancer of the liver; and, lastly, the fluctuation and vibration of a hydatid tumor are in some cases to be clearly and easily distinguished from the semi-solid feeling of cancer. But it must be allowed that, in very soft cancers with smooth surface, if constitutional symptoms be absent, as they often are in rapidly-growing medullary cancers, the diagnosis can hardly be made without an exploratory puncture, which should in such a case always be employed.[1] I have seen cases in which the disease could not possibly be diagnosed without it.

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[1] As the hydatid tumor figured in Frerichs n "Diseases of the Liver," vol. ii., p. 242, New Sydenham Society's Trans.

[2] The occurrence of simple cysts in the liver, and the frequent coexistence of that condition with cystic degeneration of the kidneys, is illustrated in papers by Dr. Bristowe and Dr. Wilks, in Path. Soc. Trans., vols. vii. and x.

[1] This sensation is not always perceptible. Davaine recommends that in order to feel it, three extended fingers be applied to the most prominent part of the tumor, and that percussion be made with the middle one. Frerichs, op. cit., p. 242.

When by puncture fluid (whether purulent or limpid) is discovered superficially situated in the liver, the question occurs whether it is right to open the collection, and if so, how? In case of abscess it would be advisable to open the collection as soon as practicable; and the safest way is by means of caustic (see Vol. I., p. 346). In the case of a hydatid tumor, it seems better to wait until the fact of growth is decidedly established; since such tumors sometimes remain long stationary, and the operation is a dangerous one. But if the cyst be increasing in size, and if it be superficial, the risk of leaving it alone becomes probably greater than that of operating. Several plans are in use. The one which was till lately, I think, the most common in English practice, is to make an opening into the sac with potassa fusa; other plans are to cut down on to the peritoneum, have the wound stuffed with charpie in order to excite adhesions, and then, after a few days, prolong the incision into the cyst; or simply to puncture and evacuate the tumor, as was done by Sir B. Brodie; or to keep the puncture open, and establish a sinus, through which the sac is washed out with warm water, diluted alcohol, solution of iodine, or even bile. Iodine is the fluid which has been generally used; but Frerichs seems to speak favorably of the use of bile as causing less pain, and correcting the putridity of the contents of the sac.

In a very interesting paper published in the Med.-Chir. Trans., vol. xlix., Dr. John Harley has related a case in which he effected the cure of a large hydatid tumor of the liver (the largest on record in which operation has been practised) by puncturing the sac above the umbilicus with a large trocar and canula, tying in the latter till it lay loose in the wound it had caused; the canula being kept free from obstruction by a catheter passed through it from time to time, and then supplying its place by two or three elastic catheters, the size of which was gradually increased until three or more of the size of No. 12 could be readily introduced. Iodine was freely injected through these catheters from time to time, and to prevent decomposition the sac was freely washed out with creasote water, of which, on one occasion, more than a gallon was passed through the sac, being injected through one of the catheters and running out by the others. Severe symptoms occurred during the treatment, from hemorrhage and discharge of bile into the sac. These were combated by strict attention to bandaging, and by the use of injections of sulphate of zinc and nitrate of silver. Dr. Harley appends to his paper a synoptical table of the published cases in which operative measures have been employed, to show the superiority of a free puncture of the sac, and its careful evacuation, over those plans of treatment in which the latter point is not secured. He rejects the method of opening the sac by means of caustic potash, as being much more painful and tedious than that by the large trocar, while it is not in his opinion at all safer. The point on which he lays especial stress is the necessity of providing free exit for the cyst-membranes, and a constant discharge for the fluid, which if retained will putrefy and poison the blood.

If there be much redness, and the fluid seem very near the surface, it may be thought justifiable to open the tumor by a simple incision; but it is dangerous, as the least escape of cyst-fluid into the peritoneum may set up fatal inflammation. If by palpation or on puncture the cyst is found to have undergone calcareous degeneration, as is not uncommon, no operative interference is justifiable.

Tumors connected with the spleen and the omentum less frequently come under the surgeon's notice, since they are not the subjects of surgical treatment. The former are chiefly known by their situation, and by their raising the false ribs on the left side, as hepatic tumors often do on the right. Cystic or other tumors in the omentum appear more pedunculated than visceral tumors, and give rise to few symptoms when solitary; but the colloid and other soft formations usual in this part, are often merely part of a general affection of the whole peritoneal surface, leading rapidly to death.

It is certainly theoretically possible that some of these looser tumors within the abdomen should be made amenable to surgical operations analogous to those on ovarian cysts; but practically it will be very difficult to find a case in which there shall be at the same time sufficiently urgent symptoms, and yet sufficient evidence of constitutional immunity, to justify a surgeon in exposing his patient to the incalculable risks of such an operation.[1]

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[1] It is a measure, however, not absolutely devoid of danger. Frerichs (op. cit., p. 251) gives a case where death was caused by tapping a hydatid cyst and drawing off some of its contents with an exploring trocar.

[1] The cases which have occurred since the statement in the text was written of removal of the spleen by Mr. Bryant, M. Kœberle, and others, appear to me amply to justify it (see the Biennial Retrospect of the New Syd. Soc., for 1867–8, p. 220), although it is true that

The Groin.

The fold of the groin is one of the most fertile regions for the materials of surgical diagnosis; but most of these materials have been already treated of. Thus, in the essays on HERNIA and on the DISEASES OF THE MALE ORGANS, all the difficult and complicated questions of diagnosis connected with hernia, retained testicle, cysts of the spermatic cord, and all the varieties of hydrocele, have been studied, and the diagnosis of psoas abscess has been laid down in that on DISEASE OF THE SPINE. Artificial anus, again, as well as iliac abscess, and the abscesses forming round the caput cæci, have been spoken of in the essay on DISEASES OF THE INTESTINES. The affections of the skin of the groin, among which intertrigo is very common, will be found described in DISEASES OF THE SKIN and ERYSIPELAS. The chief points which remain for notice are the affections of the lymphatic glands, and the rare instances of bursal tumors and cysts unconnected with the testis or cord. The tumor formed by an enlarged gland may often be confounded with a hernia; but on this point it is only necessary to refer to Vol. II., p. 734. The mobility of the glands distinguishes all except that which lies in the femoral canal. In such cases the regions from which the inguinal glands derive their absorbents, viz., the lower limb (especially the toes), the wall of the abdomen, the nates, anus, and genitals, must be carefully examined, for the disease in the groin is but a symptom. The after-consequences of abscesses forming in these glands are often formidable, since they lead to ulcers with callous edges, in which often the enlarged and diseased gland is to be seen, or to sinuses which are often very intractable. In the first place, the remains of the gland should be extirpated with the knife, or destroyed by some caustic; the latter being perhaps the best plan, as these glands have little sensibility. If this does not suffice, the hard edges are to be destroyed with potassa fusa; or, as a last resort, chloroform is to be administered, and all the sinuses laid open to their very bottom by free and extensive incisions, the hardened edges being at the ame time pared away. The wound must hen be dressed from the bottom, the paient kept at rest, and liberal diet given, f the stomach will bear it.

Cysts are sometimes found in the fold of he groin, which are formed in the bursa lying near the hip-joint, under the tendon of the psoas muscle. If this bursa communicates, as it often does, with the hip-joint, the fluid will pass into the synovial cavity on pressure, and the tumor disappear on the limb being relaxed. If the bursa is separate, the rounded tumor will be irreducible. The diagnosis will be made from a consideration of these circumstances, and from the position of the small rounded tumor. The treatment will be that laid down in the essay on DISEASES OF THE MUSCULAR SYSTEM, Vol. III., p. 394 et seq. More liable to lead to error are those cysts and those abscesses which lie in close proximity to the femoral artery and receive pulsation from it It is, however, sufficient to be aware of the occurrence (however rarely) of such diseases, and of the general rules for the diagnosis of aneurism (as laid down in the essay on that subject, Vol. II., p. 338), to avoid such a catastrophe as to mistake an aneurism for a cyst or abscess. But much caution ought to be used, remembering that sad mistakes have been committed on the subject.

Cysts of many other kinds may form in the groin—sebaceous, serous, sanguineous. Of these the sebaceous would differ in no respect from the ordinary disease as it takes place in other parts. The serous and other cysts are difficult of exact diagnosis without an operation; which should, however, be omitted until symptoms call for it. I have seen a blood-cyst dissected away from the sheath of the vessels in this part with good results. The patient was a young woman under Mr. Hewett's care.[1]

Connected with the surgery of the groin a curious and rare affection ought to be noticed, which is denominated by the German surgeons the "rider's-bone," and is attributed to ossification of the tendon of the adductor longus or magnus muscle as a consequence of injury; such as is not uncommon in riding, while endeavoring to maintain the grip of the saddle. The following case, which I quote by Mr. Birkett's permission from a paper written by him,[2] will best illustrate the subject:—

"A gentleman, fifty-six years of age, was, in early manhood, much used to riding on horseback, and regularly hunted three days a week at the least, being always well up to the hounds. He has always enjoyed robust health, and is very muscular. Twenty-five years since, when riding in a steeple-chase, at about the age

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he spleen has been successfully removed in he human subject by M. Péan, and perhaps y other operators, as a reference to the same ublication will show.

[1] Path. Soc. Trans., vol. ix., p. 383.

[2] Guy's Hospital Reports, 1868. If I am not mistaken Mr. Hancock also drew attention to this affection in his Lectures on Anatomy and Surgery as Professor at the Royal College of Surgeons.

TABLE OF THE CHIEF SURGICAL AFFECTIONS OF THE GROIN.

	Reducible.	Fluctuation.	External inflammation.	Impulse on coughing.	Resonance on percussion.	Other chief symptoms.
Abscess, psoas	Partly.	Yes.	No.	Frequently.	None.	Evidence of diseased spine. Swelling in iliac fossa.
glandular	No.	Yes.	Yes.	No.	No.	Probably other inflamed glands, and some disease in the parts from which the absorbents come.
from diseased hip	No.	Yes.	Varies.	No.	No.	Pain, involuntary resistance, or grating on passive motion of joint.
simple	No.	Yes.	Yes.	No.	No.	Resilience of fluid in a limited cavity. Inflammation of neighboring skin.
Enlarged glands	No.	No.	Varies.	No.	No.	Wound or other cause of irritation in parts from which the lymphatics come.
Cysts	No.	Yes.	No.	Very seldom.	No.	Resilience of fluid in limited cavity. No surrounding inflammation.
Encysted hydrocele	Partly, sometimes.	Hardly perceptible.	No.	No.	No.	Resilience and absence of inflammation as above, with transparency. The cord running into the tumor.
Hernia, common	Yes.	No.	No.	Yes.	If large.	Disappears occasionally, spontaneously, or on taxis.
incarcerated	No.	No.	No.	Yes.	If large.	Similar history at one time. Has since become irreducible.
strangulated	No.	No.	No.	Not usually.	Occasionally.	The sickness, constipation, umbilical pain, and other severe symptoms attendant on strangulation.
Retained testis	Partly.	No.	No.	Sometimes, but obscure.	No.	Absence of testis from that side of the scrotum.
Varix of saphena vein	Yes.	Yes.	No.	No.	No.	Increased by pressure above; emptied when the circulation is stopped in the vein below.
Aneurism	No.	Variable.	Seldom.	No.	No.	Pulsation and bruit in most cases; affection of the pulse in the trunk below.
Malignant disease	No.	No.	No.	No.	No.	Infiltration of parts around with cancer; perhaps enlarged glands and cachexia.
Other tumors	No.	No.	No.	Seldom.	No.	Gradual increase of the swelling, with absence of all the above and all other special symptoms

of thirty, in the act of charging a fence his horse, refusing the leap, swerved, and he felt something give way 'snap' in the upper and inner region of the right thigh. Immediately after he felt he had not his accustomed powerful "grip" of the saddle. In the evening, even so soon after the accident, the thigh was swollen and bruised. It should be stated that he was neither thrown from his horse nor displaced in the saddle. The muscles of the right thigh were very weak for some months afterwards; indeed, the adductors have never regained their wonted power. Both Aston Key and Liston were consulted, and stated that they had never met with a like case. For at that time there existed a bony hardness in the course of the tendon of the adductor longus.

"At this time there is a large exostosis in the region of the right spine of the pubes, which extends along its horizontal ramus, and seems to envelop the pubic attachment of the adductor longus muscle. The tendon of this muscle is converted into bone at its root, and extending for three inches downwards in its substance a conical piece of bone is clearly perceptible. The apex of this is pointed, and rounded off at its tip, as if cartilaginous. In the tendon of the left adductor longus there exists a similar bony deposit about two inches long, but no exostosis on the pubes. The other adductors are unaffected on both sides."

Dr. Billroth has described an ossification in the tendon of the adductor magnus, which he found in an after-death examination of an old cavalry-man. It extended in that muscle for half an inch below its attachment to the pelvic bones.[1]

Prof. Longmore, of Netley, informs me that he has seen the "rider's-bone," "but extremely rarely."

A similar local ossification of the soft parts, due to pressure and irritation, is stated to occur in the left arm of the Prussian soldiers, and is termed "exercise-bone."[2]

Finally, it may be advisable to call attention to the occasional occurrence of disastrous or even fatal hemorrhage from the spread of phagedænic, strumous, or cancerous ulcers in the groin. The diagnosis of these forms of ulcer presents no difficulty in the groin beyond what it does in other parts; but the peculiarity in the relations of the femoral artery should make us more than ordinarily anxious to stop the spread of specific ulceration in the groin. Powerful caustics, such as potassa fusa or nitric acid, are the only local measures which can be trusted to arrest such of these ulcers as allow of treatment. The more active forms of cancerous ulceration are, of course, hopeless.

The Popliteal Space.

The popliteal space is to be regarded, from a surgical point of view, as a large loose areolar interval in which the great vessels and nerves pass behind the knee joint, and whose size and the laxity of its tissues allow them to move freely out of the way of the ends of the bones in forced flexion and extension.

The glands which lie in this areolar tissue, the tendons and the bursæ in relation with them, must engage the attention of the surgical anatomist as well as the vessels and nerves. It is unnecessary for us here to go over the familiar points, which may be found in any treatise on descriptive anatomy; but it may perhaps serve a useful purpose to give an account of the usual arrangement of the bursal sacs which are in connection with the tendons.

In the Archives Générales de Médecine, 1856, sér. v., tom. viii., pp. 313, 425, M. Foucher has written an elaborate memoir on the tumors produced by enlarged bursæ in the ham, which will well repay perusal. M. Foucher there gives a description of the usual arrangement of the bursæ, which my dissections (though less numerous than M. Foucher's) enable me to confirm. There are found, according to this author, on the inner side of the ham, two bursæ—one between the inner head of the gastrocnemius and the femur, which sends a prolongation also between the gastrocnemius and the semi-membranosus, and is in close contact with the ligament of Winslow. This bursa very often communicates with the joint,[1] especially if it is enlarged. The second bursa, at the inner side of the space, lies between the tendon of the semi-membranosus and its insertion into the head of the tibia. It is of smaller size than the preceding, with which it is in contact above, and sometimes in communication. In such a case this bursa may communicate with the joint, but not otherwise. Besides these, I have found, but only once out of nine dissections, a small bursa between the tendons of the semi-membranosus and semi-tendinosus, which is probably an accidental formation. On the outer side of the space a separate bursa is some-

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[1] Deutsche Klinik, 1855, No. 27.

[2] Virchow, R., Die krankhaften Geschwülste, vol. ii., p. 72.

[1] M. Foucher says, almost always in adults and old persons; a point which I regard as very doubtful.

times found under the outer head of the gastrocnemius, but more frequently merely a prolongation of the synovial membrane. There is also usually a pouch of the synovial membrane of the joint, between the front surface of the tendon of the popliteus muscle and the posterior ligament. This pouch may be replaced by a separate bursa. On the opposite (back) surface of the tendon, between it and the external lateral ligament, lying close to the peroneal nerve, there is usually a separate bursa.

Besides these regular and natural structures, which can always be recognized by dissection, there are also found other closed sacs, which appear to be diseased products. Thus M. Foucher notices that, in dissecting the popliteal space, he has occasionally met with cysts having no communication with the joint, and not situated in the position of the tendinous bursæ. These cysts he believes to be in most cases dilated synovial follicles;[1] although he admits the possibility that some of them may be formed by a hernial protrusion of the synovial membrane through an opening in the ligamentous capsule, which afterwards becomes obliterated.[2] Other cysts are found, though rarely, in the cellular interspaces, which appear to be simply accumulations of fluid in the meshes of the areolar tissue, which have become enclosed in a capsule. If we follow this division, we shall have four classes of cysts in the popliteal space:—

1. Bursal cysts, or dilatations of the above-mentioned bursæ of the tendons.

2. Follicular cysts, or dilatations of the synoviparous follicles.

3. Synovial cysts, or cysts formed by hernial protrusions of the synovial membrane.

4. Free serous cysts, or accidental cysts.

It must, however, I think, be allowed that the second and third classes have not yet been proved to be anatomically distinct from each other.

The first question which occurs in examining a rounded tumor in the popliteal space is, whether it is an aneurism, an abscess, an enlarged gland, a solid tumor, or a cyst. There is usually very little difficulty in establishing the diagnosis of the latter form of disease—in fact, when the cyst projects from the outer or inner aspect of the limb, there can be hardly any ambiguity in the matter. This is the case in the great majority of instances; those cysts being, as far as I have seen, the most common which are formed by the expansion of the bursa lying between the femur and the inner head of the gastrocnemius with the semi-membranosus muscle. But when the cyst presents, as it occasionally does, in the centre of the space close upon the popliteal artery, it may very closely simulate an aneurism at first sight. The diagnosis depends upon these particulars: 1. The cyst, though it contains thin fluid, is not altered in size by compression applied while the circulation in the artery is arrested; the aneurismal tumor is emptied partly or entirely under similar treatment, while it contains fluid. 2. The sound communicated to the ear applied over the tumor is never of the same prolonged blowing character with that usually heard in aneurism. 3. The pulsation communicated to these cysts is never of the expanding character of the pulsation observed in an aneurism with fluid contents. 4. Most of these cysts can, in some position or other of the limb, be dragged away from the artery, and the pulsation in the tumor then ceases entirely, though that in the artery continues unaffected, which is never the case in aneurism. 5. To these diagnostic marks Mr. Hart, in reporting a case mistaken for aneurism,[1] has added, that in rigid extension of the limb the pulsation of the cyst almost disappeared. Finally, if, after a very attentive examination, the surgeon cannot yet make up his mind, it will be justifiable to clear up the doubt by inserting a grooved needle; but this measure will be hardly ever resorted to after a sufficient examination in any case which afterwards proves to be an aneurism.

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[1] On the nature of these synovial follicles, see Gosselin in Mém. de l'Acad. imp. de Méd., vol. xvi. He there establishes the following propositions:—

I. The articular synovial membranes in general, and that of the wrist in particular, are provided with prolongations, or culs-de-sac, which he calls "crypts," or "synoviparous follicles."

II. The obliteration of the orifices of these crypts, and the accumulation of synovia in their interior, is the origin of the cysts in question (*i. e.*, the ordinary ganglions).

These two propositions are applicable to the knee-joint, though the occurrence is less common than in the wrist.

[2] In dissecting the popliteal space on either side in the body of a woman, æt. 38, I found on each side a large accumulation of fluid in the bursa beneath the inner head of the gastrocnemius. On one side there was no communication with the joint, which was perfectly natural, and contained no fluid. On the other side the enlarged bursa communicated with the synovial cavity, which also contained a considerable quantity of the same thick yellow fluid as the bursa. But, besides, there was on this side, adherent to the posterior surface of the ligament of Winslow, in its centre, a very small closed sac, containing similar fluid. The sac and the adjoining portion of the ligament, with its synovial lining, were removed from the body and carefully examined. No communication whatever existed, but there was a distinct pin-hole depression on the synovial face of the ligament, corresponding to the part where the cyst adhered. There were, therefore, strong grounds for regarding the latter as formed by a protrusion of the synovial membrane, or of one of the above-mentioned follicles, through the ligament.

[1] Med. Times and Gaz., 1862, vol. i., p. 377.

It is impossible sometimes to diagnose the nature and connections of blood-cysts before dissection. Of this the following interesting case is an example: A woman was under the care of Mr. Moore, at the Middlesex Hospital, for a smooth swelling in the popliteal space, supposed to be a bursa. In a few months after she was first seen, the tumor appeared solid, deep-seated, and was thought to be a cluster of glands. Again, ten months later, it nearly doubled the size of the knee, projecting backwards in lobes between the hamstrings and gastrocnemius. It was doubtful whether it was solid or fluid, its feeling varying at different examinations. The chief symptom was acute pain darting along the nerves to the foot. Sometimes she could not bear a touch. On puncture with a grooved needle, slightly reddened serum escaped, which, as it flowed, became more and more red, till at last it became pure blood. Whilst the needle was held steady in the tumor, she suddenly cried out from excessive pain shooting to the foot. For three or four minutes after the needle was withdrawn, the tumor remained soft; but then acquired the same tension as before. A tourniquet was applied, and the tumor cut into. The sensation to the finger was exactly that presented by the right ventricle of the heart. Nothing but blood and a few fibrinous coagula escaped; the venous bleeding was very free. The limb was amputated, and the disease then proved to be a cyst, communicating with some deep vein, and developed like a neuroma in the substance of the posterior tibial nerve, the fibrils of which were expanded in all directions over it.[1]

Treatment of popliteal cysts.—The treatment of these cysts is usually successful. It may be conducted on the same principles as those already laid down in the essay on DISEASES OF THE MUSCLES as applicable to enlarged bursæ of tendons. But the frequency with which a communication exists between the enlarged bursæ of the hamstring tendons and the joint, and the probability that the cyst, if seated in the centre of the ham, may be a protrusion from the synovial membrane, should make the surgeon very cautious in treating these cysts by any of the severer methods, such as injections and setons. It it quite true that such methods have been used, and successfully, when the cyst has been known to communicate with the knee joint;[1] but they must always be held to be dangerous, and should not be resorted to unless after a patient trial of other methods (such as puncture, followed by blistering) which are free from any risk. These mild measures will often succeed, when combined with rest. Nor should it be forgotten that the communication with the joint is not always obvious even in cases where it exists. The opening may be but small, and pressure on the cyst may cause no appreciable quantity of fluid to flow into the joint, unless applied for a considerable time; or the opening being of the nature of a slit,[2] may be closed in the extended position of the joint, though open when the knee is flexed. In any case, if injection be the method employed, the knee should be kept firmly extended. Iodine seems the best material for injection, though alcohol and ether have been successfully employed. The injection-treatment seems to have been so successful that the difficult and dangerous method of excision ought not to be resorted to in any case; and when the cyst communicates with the joint it is wholly out of the question. Setons should be reserved for use on the failure of injection.

The diagnosis between an *abscess* in the ham and any of the affections with which it may be confounded is usually very easy. The inflammatory appearance of the integuments would suffice to distinguish it from a cyst, as well as from a solid tumor.[3] The chief ambiguity would be between an abscess and an aneurism in which suppuration of the sac has taken place, or between an abscess following injury and an effusion of fluid from rupture of the main vessels. On both these heads the investigation of the pulse in the artery below will give important and often decisive information. As to suppurating aneurism, the history and symptoms of aneurism will have existed, and, if the patient is a person of any intelligence, will not fail to guide the surgeon to a right conclusion. In such cases the aneurismal bruit and pulsation have generally been obliterated by the inflammation. It is true that an incision will be required, both in the abscess and in the suppurating aneurismal sac; but it is most important not to open a sup-

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[1] Med.-Chir. Trans., vol. xlix., p. 29.

[1] Foucher, op. cit., obs. i., p. 321.

[2] See a case dissected by Foucher, op. cit., p. 320.

[3] It should be remembered that cysts may suppurate as well as enlarged glands, and that abscess may occur in or near a solid tumor; but then such cases become abscesses, and must be so treated.

TABLE OF THE CHIEF SURGICAL AFFECTIONS OF THE POPLITEAL SPACE.

	Fluctuation.	Pulsation.	Bruit.	External inflammation.	Variation in size with the pulse.	Remarks.
Abscess (simple or glandular) . .	Yes.	Seldom, and never expanding.	No; or very rarely a simple "thud."	Yes.	No.	When dependent on lymphatic inflammation, there will be disease in the parts from which those vessels are derived.
Abscess from diseased bone . . .	Yes.	No.	No.	Usually a sinus.	No.	Thickening around the bone, which can probably be struck with the probe.
" " " joint . . .	Yes.	No.	No.	Usually.	No.	Crepitus of the joint surfaces will, in all probability, be detected under chloroform.
Bursal tumor, or cyst	Yes.	Seldom, and never expanding.	No; or merely a simple "thud."	No.	No.	The bursal cysts can frequently be emptied into the joint when the leg is bent; if they pulsate, this can generally be made to cease by drawing them away from the artery.
Aneurism	Variable.	Yes, almost always.	Usually.	No.	Yes.	
" suppurating	Yes.	Usually not.	Usually.	Yes.	Probably.	The pulse below is probably affected.
Rupture of artery	Yes.	Not usually.	Variable.	No.	Cannot often be made out.	The history is generally decisive; the swelling and color of the limb, the loss of temperature and the impending gangrene, are also generally unmistakable symptoms.
Glandular tumor	No.	Seldom, and never expanding.	No; or merely a simple "thud."	Usually not.	No.	The same remarks apply, as to glandular abscess.
Other innocent tumor	As above.	As above.	As above.	No.	No.	This and the preceding tumor can usually be drawn away from the course of the vessels, like the bursal cysts.
Cancer	Variable and varying in different parts of the tumor.	No.	As above.	No.	No.	The rapid increase in the tumor and the large veins over it are frequent symptoms.
" pulsatile	Sometimes.	Yes.	Not usually.	Seldom.	Yes.	As above; it is only in rare cases that the bruit simulates that of aneurism. The bone is commonly enlarged for some distance.

purating aneurism, believing it to be a simple abscess, since amputation may become immediately necessary—a contingency for which the surgeon should assuredly have prepared both himself and his patient.[1]

Rupture of the great vessels in the ham always, as far as recorded cases show, implicates the artery. The vein also may be torn in cases of ruptured artery; but I am unable to refer to a case where it has been the only vessel injured. The accident would be diagnosed from abscess by the suddenness of the occurrence of swelling, which comes on instantaneously at the time of the accident; the absence of inflammatory œdema or increase of temperature in the superficial parts of the ham, the loss of temperature in the foot, the failure of circulation in the lower arteries, and the tendency to gangrene.[2]

The treatment of ruptured artery has been spoken of in the essay in ANEURISM, Vol. II., p. 385.

The regional surgery of the popliteal space would be very incomplete without the mention of that which is perhaps the most common cause of embarrassment in operations conducted in this region—viz., the frequent formation of a sequestrum in the part of the femur directly adjoining the popliteal artery. This sequestrum is seldom separated from the vessels by an invaginating sheath, as is usually the case in other parts of the body. No satisfactory cause for the commonness of the disease, or for the frequent absence of the periosteal sheath, seems to have been given. Numerous accidents in the removal of these sequestra have happened; the artery has been opened by the knife or the trephine, or lacerated by the sharp edge of the sequestrum; and cases in which the loose bone has been driven into the artery in the ordinary movements of the limb are on record, and have been referred to at Vol. III. p. 145. Hence much caution is necessary in extracting such sequestra. A free incision at one side (the outer is best) should be made, and the dissection carried along the face of the bone until the dead bone is reached. If it be not thoroughly loose, the operation had better be deferred till it shall become so. If it be found loose, it should be gently raised from its bed with an elevator, and drawn outward with flat forceps. If the extent of the dead bone be too great to allow of its ready extraction, it is better to cut it across with the bone-scissors than to use any force. If, notwithstanding all his care, the surgeon is so unfortunate as to wound the popliteal or any large artery, he must have the circulation commanded by pressure on the femoral, while he rapidly enlarges the wound and ties both ends. Failing this, amputation has been found necessary, and even death by hemorrhage has occurred.

The Limbs.

In the continuity of the limbs, the chief questions connected with regional surgery which occur in practice are those which relate to the relative positions of arteries and nerves to tumors or diseased portions of bone. Interesting points of surgical anatomy are frequently raised by these operations, but they are too numerous and too miscellaneous for discussion here. An intimate and ready knowledge of anatomy is the chief requisite for safely conducting such operations; but the surgeon must not forget that tumors and abscesses often displace the structures. An instance of this has been given at p. 915, in the displacement which the femoral artery suffers in chronic abscess of the thigh; and similar displacements are of course still more common when tumors grow among the main vessels and nerves of a limb. For this reason, in the removal of such tumors, it is very desirable to commence the dissection from above, where the structures have their natural position, and thence trace them downwards. But the affections of the limbs have been so extensively described in the essays on the DISEASES OF THE MUSCULAR SYSTEM, BONES, JOINTS, and SKIN, that I must refer the reader to those essays for all that is necessary on their diagnosis and treatment.

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[1] Most readers will recollect the case, so well described by Roux (Quarante Années, etc., vol. ii., p. 48), in which Cullerier opened a suppurating aneurism in the groin.

[2] Compare Poland on Rupture of the Popliteal Artery, in Guy's Hospital Reports, ser. iii., vol. vi., 1860.

ON HOSPITALS.

By Sir J. Ranald Martin, C.B., F.R.S.

Revised by Norton Folsom, M.D.

If there be any merit in the following attempt, it consists in having brought together the scattered elements of a subject not as yet generally understood as a whole. The endeavor may be well capable of improvement, as well as of extension; and I shall esteem myself fortunate if I may at some future time enjoy the privilege of contributing both to the improvement and the extension of so beneficent a subject.

To pretend to originality in such an undertaking would be about as just and true as to pretend to write the original statistics of an empire, or to write a cyclopædia.

In considering the objects and uses of hospitals we must always hold in recollection that, however excellent and necessary in themselves, they have but a subordinate station in the great body politic of medicine, comparatively. They relate only to the cure of disease; and thus minister, according to Bacon, but to the "necessities of mankind;" while the nobler division of the science of medicine aims at the promotion of the general welfare by ministering "to the Divine power and goodness both in prolonging and restoring the life of man." Dr. William Farr, quoting the same great authority, says: "If physicians" (and we may add governments) "will learn and use the true approaches and avenues of nature, they may assume as much as the poet saith:—

> 'Et quoniam variant morbi, variabimus
> artes;
> Mille mali species, mille salutis erunt.'"

The objects and uses of hospitals are: the recovery of health; recovery from sickness in the shortest time, and with the smallest mortality, and at the lowest cost consistent with efficiency.

But an army in hospital—as at Walcheren, at Rangoon, and in the Crimea—what availeth it to the statesman or the commander? It is an encumbrance, a waste, almost a nullity.

I have treated the subject of hospitals, civil and military, as one; always to be regarded, in fact, as but kindred institutions for the treatment of the subjects of the state in civil life, and for that of organized bodies of men, the servants of the state, as seamen and soldiers; and therefore, again, as institutions, one and the same in purport and object. They differ in the class of persons subjected to cure; and this circumstance ought to cause no other feeling in the officers employed than an honorable rivalry.

Hospitals are in some sort the measure of the civilization of a people; they are better adapted to its wants, and better constructed, in proportion as communities are united, more humane, and more instructed. They may be regarded likewise as nature's schools, where pupils are taught her ways in diseases and casualties. As asylums for the sick and hurt, they are the most splendid expressions of wisdom and benevolence; particularly in the immediate assistance they afford to external injuries. So important, indeed, is their right management to the welfare of armies, that negligence in this respect may produce vastly more injury than twenty sanguinary battles.

Hospitals are, then, to be considered under two points of view: the first object is, to provide healthy and commodious lodgings, and attendance, medical and surgical, with assistance and suitable diet; the second object is, to provide schools of instruction for students in medicine and surgery.

In an assemblage of men united into one society we shall find a certain number of poor, a certain number of sick—the one and the other being a charge upon the public. The extent and number of hospitals in a city would appear to be regulated by the amount of indigence and sickness compared to the population. But as all inhabited places are not equally healthy, nor all industrious classes equally healthy and prosperous, it sometimes happens that in populations of equal numbers there will be more poor and sick on the public charge in one place than in another; besides which, certain hospitals admit a class of sick which are not received in another. Certain towns comprise a large district, while others offer a kind of thoroughfare. These accidental circumstances render it necessary to increase hospitals, and certainly break the relation of the extent of charitable institutions to that of the populations. Add to this, that it is not known in a given number of inhabitants what is the number of the necessitous and of the sick who require charitable institutions. On this point one can only have recourse to facts drawn from the hospitals themselves, compared to the population, to the nature of the trades, especial charities, and to the position of each town; but it is of importance that we should have them collected, in order that we may be enabled to draw useful results from them; it is a work necessary to be done, to guide us with safety when it concerns the procuring an hospital for a city.

The wants of humanity are various, numerous; they claim different kinds of relief; those who receive succor from them are in different positions. It is necessary, therefore, that there should be many modes of assisting the distressed poor. There are ills which can only be treated in hospitals; others for which houses of refuge are necessary; others, again, to whom succor can only be effectually given in their houses.

The hospital—the equivalent to the *hospitium* of the Romans, and to our own *hotel*—was, in cloisters, the place of shelter to strangers, whether rich or poor. Bearing some resemblance to our present hospitals were the public buildings for aged women of Delos, built on the island called Rheneia; and those buildings which at a later period were erected near the temple of Æsculapius for sick persons coming in search of health. It was possibly a similar institution which Antoninus built at Epidaurus. Another appears to have existed on the island of the Tiber at Rome, to which sick slaves were brought to be healed. Bethesda (house of mercy), with its five porches, was a place in Jerusalem to which the sick were brought to await the moving of the waters. Also the *Taberna Emeritorum* at Rome appears to have been an hospital for invalids.

So early as the Council of Nice, A. D. 325, hospitals are spoken of as commonly known; but the first celebrated hospital was that of Cæsarea, A. D. 370–380, richly endowed by the emperor Valerius. It was of immense dimensions. After it folowed the hospital of Chrysostom at Constantinople. In the ninth century there were twenty-four hospitals in Rome alone. A foundling-hospital was established at Milan, A. D. 787; and a lazaretto about he same time in Constantinople; and an rphan-hospital in the same city, A. D. 090, by Alexius I.

A consideration of the political, social, moral, and religious state of pagan antiquity must render it self-evident that they had not, and could not have, hospitals founded on the principle of CHARITY—a virtue of Christian origin. To Christianity solely, then, do we owe the institution of hospitals for the reception and cure of the sick; the very scattered and uncertain notices to be found in the histories of the Greeks and Romans, as of Asiatic nations, exhibiting only doubts and uncertainties. It was Christianity alone which really and practically revealed the truth that all mankind are one, and that human nature is the same in all. Christianity has not only its abasing, but its *elevating* side; and the tendency here quoted may be accepted as an essential part of the history of Christendom.

The general impression of western oriental scholars, and travellers in the East, has been that hospitals, properly so-called, never had existence in India. "An hospital for the sick poor," says Tennant, "was never known in India before the British; though there were places of reception for dogs, cats, lions, and other animals, but none for men;" while the stately edifices of Greece and Rome, and of other pre-Christian times, were erected for purposes other than of charity

"Nothing," says Mr. Raikes, "astonished the earlier European traveller in India so much as the solicitude of the Gentoos for insect-life, and their profound indifference to human suffering—men died by the road-side uncared for, but for bugs and fleas regular hospitals were furnished."

It is but fair to state, however, that my friend and a brother officer of the Bengal Army, Dr. T. A. Wise,[1] speaking of the Buddhist religion, when at its height in Hindustan, B. C. 220, mentions the priests as establishing hospitals, in which the sick and wounded were carefully tended, by the erection of medical houses or hospitals, having depôts of medicines for the sicknesses of man, and of animals. These, the first hospitals on record, were provided with skilful physicians, having all sorts of instruments and medicines, consisting of mineral and vegetable drugs, with roots and fruits—all at the expense of the state.

On the overthrow of the Buddhist system and the restoration of that of Brahma, the former power disappeared from India with its temples and monasteries, all which were desecrated and destroyed, or converted into places of Hindoo worship; so that the duration of the improved hospitals of the Buddhists could not have been long.

General Baron Ambert says: "Neither Greece nor Rome, great and glorious as they were, had their hospitals, whether civil or military; neither Greece nor Rome could have given birth to the Sister of Charity. Civilization may produce heroism, which enlightens and influences; but Christianity alone can engender charity, which warms and kindles."

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[1] Review of the History of Medicine, vol. ii., pp. 389, 390. 1867.

Cæsar states that on the night preceding one of his battles, he ordered the sick and wounded to be conveyed to the nearest town. This precaution of removing the sick from the camp, and collecting them in a town, where they could enjoy repose and the best assistance, is surely the principle of the institution of military hospitals. Fabius, after his victory over the Veii, is said to have distributed his wounded among the nobility, who opened their houses for their reception. Severus ordered that chariots should follow the army on the march, for the conveyance of the wounded, who were subsequently placed in the charge of families, who were paid by the state for their care and outlay. These are the first ambulances on record, according to Mr. Fonblanque; who adds that, notwithstanding the soundness of the administrative system and the advantages of good roads and depôts, the Roman soldier was required to render himself as independent as possible of extraneous aid, and to carry from fifteen to thirty days' provision of grain, in addition to his armour, his weapons, his handmill and cooking utensils, and his palisade. But, along with perfection of training in the individual soldier, there existed a great military administration—a commissariat department.

During the Crusades, and while the science of destruction had made rapid strides, that of preservation and cure had retrograded, and the unskilled devotion of individuals could do little to assuage the horrors of famine, pestilence, and the sword. Yet the example had been set of providing an asylum for the victims of war; the claims of the suffering soldier had been recognized; the virtue of humanity had been reduced to practice; and a precedent had been established, of which future generations derived the benefits. While prudence and humanity were lost in fanaticism, and only one-tenth of what was dignified by the designation of army reached its destination, it is nevertheless to this period that we may truly trace the first attempt at the establishment of what must be regarded as military hospitals. The Crusaders who escaped the dangers of battle fell victims in great numbers while performing the humblest offices of an hospital-nurse among their plague-stricken comrades.

It is curious in the history of progress to observe how gradually and imperceptibly philanthropy, from being only a speculative principle—a mere sentiment or abstraction—came to be a vast power; at one time to cause the abolition of slavery, and at another to bring cheap bread to the poor man's board. The interests of society at length forced it into general acceptance; but so great a change required many centuries for its maturity. A benevolent principle is implanted in our nature, which, independently of the sense of duty, or of the approval of reason, induces us, by an involuntary motion, to relieve the distresses of our fellow-creatures, and those of our native country especially. Under the influences of a benign religion, operating upon those impulses of our nature, we perceive our country covered throughout with the most noble institutions for the sick and the distressed. Their establishment reacts favorably on the public mind. Hospitals improve the disposition of mankind by cultivating charity. A degree of dependence upon public opinion and munificence is therefore useful.

The miseries of the Crusades among the military classes, and the extension, violence, and duration of leprosy among the peoples of Europe, brought about a necessity, in the middle ages, for the establishment of hospitals; and we find that Childebert, the son of Clovis, raised such establishments as the Hôtel-Dieu of Lyons, that of Paris, and of Autun, which were enlarged and improved by succeeding princes. In truth, we possess abundant practical proofs, both ancient and modern, in every country in Europe, of the interest and solicitude with which institutions have been erected for the cure of the sick poor; and the names of their founders are held in perpetual honor. It is true that in the lustre of public charities, misery, of a nature not immediately to attract the eye of pity, often remains unnoticed. But society must be content to do what can be done.[1]

Military surgeons are seldom mentioned in the records of our own armies in remote times. In the list of Henry V.'s army surgeons are included; but how they were entertained and paid does not appear. The disproportion between the troops employed and the persons engaged to attend to the injuries they received in action was always very remarkable. The fact was that the poorer soldiers, when seriously wounded, were discharged with a small gratuity to find their way home as best they might; a practice founded on the economical principle which prevailed as late as the sixteenth century—that "it costs more to cure a soldier than to levy a recruit."

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[1] "No mention is made of field-hospitals or army-surgeons in the middle ages until about the fifteenth century, when field-surgeons were appointed for the use of the commanders and principal officers, but not for the service of the field-hospitals. In no part of Europe was the administration of hospitals rescued from the hands of the clergy. Even on the field of battle priests were esteemed above surgeons, if we may depend on Mochsen, who states that by order of the first council of Ratisbon, every commander should have two bishops, with priests and chaplains, and every colonel should be attended with a confessor." Dr. Meryon's History of Medicine.

"We cannot help wondering at the innate love of a military life, or the utter insensibility, whichever it was, that induced men to flock to the standards under such dreadful circumstances, and to spare neither life nor limb, to do to the very utmost the duty for which they had engaged.

"From numerous entries in the wardrobe accounts of Edward II., it appears that it was customary to send disabled soldiers and others in the king's service to a religious house, as to a hospital, to be there supported, either for a time, or during life. This was called 'having garrison in monastery.'"[1]

The Hôtel-Dieu of Paris is said to date from the end of the seventh century. It is placed near the greatest temple of the capital; "The place where the people pray, and the place where they suffer, are alike the house of God."

The earliest notice of the establishment of an institution for the reception and cure of sick in England, is contained in the life of Lanfranc, Archbishop of Canterbury, in 1070. In this building there are said to have been separate apartments for men and women. But, before the foundation of any institutions having the character of hospitals, the germ of the provision now made by law for the relief of the indigent was planted by the Christian Church, in the devotion of a third of its tithes, ratified by express enactment of the Wittan, to that charitable aid which was administered by the clergy to the poor. The idea of a provision for indigence by a charge on all fixed property was of much later growth. That was a regulation of police which gave security to life, in order to protect property by suppressing vagabondage and crime.

Looking to modern times, we find that after the Reformation in England, by the dissolution of the monasteries and the consequent abolition of monastic orders, he way was happily opened to their conversion into charities on the present sysem of establishment. These events unveiled all the mysterious management by which benefactions had been received and misapplied; and gave every benefactor ot only the power of founding, but also of making rules for the foundation; hence these have become open to general inspection, and the intention of any benevolent donor is carefully fulfilled. The result has been, that private and public charity has become universal. The veil of humility and charity conceals an enormous amount of private benevolence; but the benevolence which is public in England is seen everywhere. In England, philanthropy may be said to be reduced to a general system, and benevolence with bounty on the largest scale are as customary as habits of business.

Many of the hospitals and "hospices" in foreign capitals combined the functions of our English hospital with those of our Poor-Law Board, provision having been made in them not only for the cure of the sick, but also of the infirm and insane. "The first military hospital established in Europe," says Mr. Fonblanque, "was erected by order of Richelieu, at Pignerole in Piedmont, where the building still exists." The hospitals of London, as those of Paris, have been alike founded by individual charity. Not to speak of legislative and parochial systems of taxation for the support of the poor, no part of the army or navy, the church, or other establishment; not the smallest congregation for worship among the many denominations of Christians or Jews; not the smallest district or set of hamlets, unknown to the passing traveller, and too insignificant to find a place in the map; not a town or city, parish or ward throughout the United Kingdom; not a manufactory; not a corporate association, company for trade, agriculture, science, education, or medicine; not a club for the enjoyment of festivity, or the pleasures of the chase, or for the indulgence even of luxury in her various folds; not even a theatre—will be found without their respective institutions of charity, to which a willing and prompt subscription flows almost without solicitation. Thus every individual in England, according to Mr. Highmore, becomes a benefactor to others, and thereby is the greatest benefactor to himself.

We have in all this the practical proof that, in our native country, one of the first of duties is held to be to feel for man, and that the most distinguished ability and the greatest success in life are valueless when that duty is neglected.

It results from this universal diffusion of charity, that there is not a disease that can afflict human nature, nor a want which the varying condition of man can require, nor any one of the manifold visitations of adversity, in poverty or distress, but finds an open asylum, a resort ready prepared with every needful accommodation for reception, entirely free of expense.

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[1] Sir S. D. Scott's British Army.

But while our feelings are divided between wonder and admiration of the magnificent moral display of national and individual charity—the most benign of all the virtues, "the very bond of peace and of all virtues"—we must not allow ourselves to suppose that in England benevolence has at any time been permitted to rush heedlessly at the object of its desire, unrestrained by POWER and ORDER; for far otherwise has been the fact. That which indeed graces the British capital, almost as much as its noble charities—"the memorials that renown our city"—is, the great and unquestioned character of the general administration of its public institutions. It is thus that London, in the magnificence, and in the comprehensiveness of its associations and societies, reflects the moral qualities of the United Kingdom.

In presenting the following details of construction and arrangement for hospitals, I have quoted from different sources, and most of all from the writings of Miss Nightingale, in her Notes on Hospitals, a work affording at once the largest and most matured experience, with the best descriptions that I am acquainted with.

In concluding her invaluable observations on "the sanitary condition of hospitals and hospital construction," she offers the following characteristic exhortations: "I have here given the defects; few have had so sad or so large an experience of their results as I have had. I appeal to those who are wiser, and have more practical power than I have, for the remedies—to architects, to hospital committees, to civil and military engineers, to medical officers, to officers of health, to all men of science and benevolence, of whom our country is so justly proud. It is hard that in a country where everything is done by a despotic government, such advances in the sanitary construction of hospitals should have been made, and that our England, which ought to take the lead in everything good, should be left behind."

I have also consulted various British and foreign authorities on the subject of hospitals, both civil and military; as Pringle, Lind, Blane, Robert Jackson, Brocklesby, Donald Monro, Aikin, Percival, Blizard, Champney, Highmore, Rollo, Stewart, Henderson, Ballingall, Lee, Wilde, Phelan, Carter and Cross, Parkes, Roberton, Walker; Construction of Hospitals, by Douglas Galton, C. B.; General Report of the Barrack and Hospital Improvement Commission, The Builder, Encyclopædia Britannica, N. British Review for August, 1858; Journ. Statist. Soc. of London; The Charities of London, by S. Low; Report, 1837, of Commissioners of Charities in England and Wales; Report of Commissioners on Hospitals of Dublin, 1856; Dr. William Farr on Vital Statistics, and his various sanitary reports; also the Sixth Report of the Medical Officer of the Privy Council for 1863. Of foreign authors these are the principal authorities referred to: Tenon, Recalde, Daignan, Iberti, Delaunoy, Breschet, Courtin; Arrêts des Conseils; Rapport fait au Conseil général des Hospices; Tardieu, Hôpitaux et Hospices; Cours d'Administration militaire, par M. Vauchelle; Rapport sur Hôpitaux, Hospices, et sur la Mendicité, par E. Cerfbère.

SITE AND CONSTRUCTION.

If it be undisputed that hospitals may be made to render great services to the public health, it is equally so that the nature and amount of such services must depend on the rigor with which we attend to their sites, construction, and administration. The site should be of established healthiness, having nothing to prevent free circulation of air all around; the ground should be free from impurities, and from surface moisture, the natural drainage being sufficient and available; never receiving the drainage of higher grounds. The Chirurgical Society of Paris proposed in 1864 that no hospital should stand on less space of clear ground than 540 feet to each patient; so that an institution for 80 patients should, at the least, stand on the centre of an acre of ground—the proportional area to increase with the number of patients.

Here it may be observed, as to construction, that the ward is the true and only foundation of the hospital; once given a perfect ward, and we have but to multiply it, upon a proper soil, and a sufficient area, and the hospital is complete. In our older histories we find terrible examples of the destruction of health and loss of life caused by neglect in these essentials.

Hospitals, in common with all public buildings—in common, indeed, even with the towns and cities in which they may be placed—are, to their inmates, but places of reception and accommodation of the day, for the purposes of the day, and exhibiting in their structural arrangements the ignorances of the day; to give place, however, in due time, and as observation guided by science may dictate, to other and more perfect structures. It is but the natural progress in science and skill. We see it, in fact, in operation throughout London at this very day, and in every hour of every day.

If we had carefully considered the nature of man in health and in disease, along with his various requirements under each condition, our hospital-wards and our barrack-rooms would not have been constructed like an hotel, having room within room, on principles purely arbitary, or on no principles at all.

"It should never be forgotten for a moment," says Miss Nightingale. "that on the purity of the air of a ward depend, in a great measure, the recovery or death of the sick and maimed, the usefulness or injury arising from the hospital, the duration of cases, and, consequently, the hospital economy; whether, in short, an hospital, planned, erected, and supported 'by voluntary contributions,' is to be a blessing or a curse to civilization."[1] And when we consider that a man cannot forego this supply of air so many minutes as he can forego food for days, is it a subject for wonder that pure air should be the main condition, as of health, so of recovery?

The desideratum to be determined by sanitary and architectural science is this: can we, by a proper selection of site, and by proper structural arrangements, rescue the inmates of our great hospitals of the United Kingdom from a mortality, which, according to Miss Nightingale, ranges from "four and a half per cent. to nearly sixteen per cent." These averages are reckoned *on the cases treated.*

On the geometrical dispositions of the architect depend, not only the renewal of air, so indispensable to an hospital, but in a great measure its interior police, the regularity and promptness of the service. With simple forms of distribution adapted to the wants of hospitals, nothing escapes supervision; in one *coup d'œil* we embrace the service and the sick, while we secure care and exactness in the performance of duty.

The following principles of construction are presented as the best hitherto discovered:

1. That no hospital shall consist at most of more than two stories in height.

2. That by this arrangement the sick re spread over a wider area, the walls ot being so high as to interfere with the entilation and sunlight of neighboring avilions; while the accumulation of hosital miasm in the upper floors is avoided.

3. That the construction by two stories acilitates the access to the wards by atients and attendants, and the whole dministration is rendered easy.

4. All the most approved hospitals on he Continent, as the Lariboisière of aris, are built in as many as three flats; nd it would there be esteemed nothing short of breach of trust to erect lofty and massive buildings within a crowded city.[1]

5. In constructing wards, they should be so built as to be flooded with sunlight, and the windows should bear a large proportion to the wall-space of the hospital. Experience proves that window-space ought not to be in a much less proportion to wall-space of an hospital than one to two.

6. The free admission of light has everywhere been proved beneficial to health and conducive to cheerfulness; while, as often observed in ill-constructed barracks and hospitals, the exclusion of light has proved detrimental to health directly, and also by retarding convalescence.

7. The best principle of hospital construction is that of separate pavilions placed side by side, or in line. The former is very preferable for large hospitals, for the reasons already stated; and there should be but two flats in a pavilion,

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[1] Pouteau, looking at the ill-placed, ill-nstructed, and ill-regulated hospitals of his y, asks: "Are hospitals, then, more percious than useful to society?"

[1] Miss Nightingale says: "There should not be more than two floors of wards to the block. The most healthy hospitals have been those on one floor only; and this because they require less scientific knowledge and practical care in ventilation. If another floor is added, a community of ventilation exists between the ward below and the ward above the common staircase, and by filtration of air upwards through the floor. The risk from this can be diminished by constant care in the use of doors and windows, and by introducing impervious floors. But, unfortunately, systematic care in these matters is not to be looked for, especially that constant supervision necessary to keep the ventilation of three or more floors of wards quite independent of each other (who ever sees this even in private houses, when there is an invalid?) and hence there is a strong conviction in the minds of careful hospital physicians, surgeons, and nurses, that patients do not recover so well upon upper floors. Moreover, the *sick population* requires more surface for health than a healthy population; and it is clear that if patients are placed on three floors instead of two, the surface over-crowding is increased by one-third, unless the distance between the pavilions is increased in a corresponding ratio. But the general administration of lofty hospitals is also far more difficult and fatiguing than those of moderate height. Any increase of distance between the pavilions will add to the difficulty, and both difficulty and fatigue are very important considerations for efficiency and economy in this branch. To sum up—hospitals on one floor require least care; those on two floors can be kept healthy with moderate average care. Beyond this, care, intelligence, and fatigue, such as are rarely likely to be bestowed, are essential to maintain a moderate amount of health, among either wards or nurses."

and one ward, to a flat. Pavilions are, in fact, separate hospitals, having a limited number of sick under one roof.

8. The form of the hospital should be an oblong square, the basement story of the pavilions being connected by a corridor, and the whole of the basement erected on arches. The pavilion plan is generally received on the continent as the sanitary necessity for hospital construction.

9. It is undesirable to increase the width of any ward beyond thirty feet, because the distance between the opposite windows becomes then too great for efficient ventilation.

10. Windows should be double, or glazed with plate-glass, to prevent loss of heat. Tripartite windows, like those of the Middlesex Hospital, are useful for ventilation.

11. The ward-walls should consist of pure white Parian cement, or some equally white non-absorbent substance. Gray-colored cements should be avoided; they never look clean, and they give the ward a sombre appearance, and hide dirt.

12. The best ward-flooring is oak; and the joints of the flooring should be well fitted together, so as to be impervious.

13. No sawdust, or other organic matter capable of rotting, should be placed underneath hospital floors.

14. Floors should be bees-waxed, or oiled and polished.

15. The general baths of the hospital should be separated from the pavilions, but connected with the corridor. They should contain hot and cold water, medicated, sulphurous, Turkish, vapor, shower, and *douche* baths.

16. The kitchen should have walls and ceiling of Parian cement, or other such material.

17. There should be a head-nurse's room and scullery attached to each ward, and store-presses outside the wards.

18. Bedsteads should be of iron, and be supplied with hair-mattresses. The ward furniture should be of oak. Whether regarded as a means for securing sleep, rest, muscular relaxation, or repose, the bed is a direct auxiliary to the cure, and too much care cannot be given to its construction and situation.

19. The ward construction now described is that which, up to the present time, experience has shown to be best suited for fulfilling all the requirements of ventilation, light, cheerfulness, recovery of health, and economy, in this country.

20. One great advantage of the proposed system is, that it admits of any arrangement of the pavilions on a plan which is consistent with light and ventilation. Hospital establishments so constructed may be added to without difficulty and without altering, or indeed without interfering with any of the existing pavilion buildings.

21. The principles of hospital construction here advocated are at variance with those of almost all the old hospitals of the three kingdoms; but the whole question, in all its importance, is in the hands of the profession and of the public; and observation, experience, and free discussion, will ere long determine what is just and true.

22. Most of the great hospitals and charitable institutions of this country were suburban at their foundation; the rapid growth of our towns in modern times has encroached so much upon space once country, that gardens and fields have been absorbed, and are now covered with bricks and mortar; and hospitals are surrounded by the screaming and roaring traffic of railways, street-cabs, omnibuses, and wagons.

23. It is due to the founders of our great charitable institutions that their humane intentions should continue to be realized by removing the sick and maimed to pure air and quiet. It is due to poor suffering humanity that any plans adopted should be the most perfect which modern intellect can devise; and it is no less due to the cause of charity that there should be the best and most economical form of hospital nursing and management.

24. I have here confined myself to a consideration of the best known plans of hospital-construction, believing that a review of second- and third-rate plans is but waste of time. In crowded cities we must be satisfied with what can be done; but I feel assured that, wherever practicable, such plan and arrangement as those of Miss Nightingale, will in the end prove the cheapest, whatever the price of ground may be.

The following is a brief summary of the principles of hospital-construction here recommended:—

(*a*) Never erect a general hospital within the precincts of a town, or in suburbs likely to be built upon.

(*b*) Remove all general hospital establishments out of town, and from populous suburbs, as soon as circumstances may permit; or when such removal is not practicable, let all the available ground around the institution be purchased.

(*c*) Build all general hospitals in the country, on areas of ground sufficient to admit of extensions of buildings, and to prevent other buildings from being erected within such a distance as shall interfere with a free circulation of air and with quiet.

(*d*) Select a mild and dry climate.

(*e*) Give the preference to a porous self-draining subsoil, and avoid ground saturated with organic matter, especially old graveyards.

(*f*) Build all hospitals on arches, to admit of a free circulation of air underneath the ward floors.

(*g*) Let the plan be simple, and have as few closed angles and corners as possible.

(*h*) Do not provide for more than 120 patients or beds under one double pavilion roof. If the hospital must contain a larger number of beds, increase the number of pavilions by corridors running between the ends, and no higher than the ground-floor.

(*i*) Plan any hospital with no more than two flats, containing, in a single pavilion, two super-imposed wards. Provide for convalescents and "casualty" cases in pavilions separate from the ordinary sick.

(*j*) Provide for no more than 32 beds in a ward (16 on each side), with a window to every two beds.

(*k*) Let the window-spaces be, as near as may be, in the proportion of one to two of the wall-space. The windows should reach from within three feet of the floor to within one foot of the ceiling.

(*l*) Wards should not exceed 30 feet in width. The construction of a small ward may be sanctioned only for the separation of very bad cases, or for the reception of cases of extraordinary severity.

(*m*) Each bed should have from 1500 to 2000 cubic feet of air-space. In very exposed and airy situations, the smaller cubic space will suffice; but where, from the nature of the ground, there is not likely to be much horizontal external movement of the atmosphere, the larger the internal cubic space is the better. In our temperate climate 90 square feet per bed may be taken as a fair average for its superficial area; while this space must be increased where the site is faulty, or where a Medical School has to be provided for. One hundred and twelve feet are considered necessary for purposes of nursing and teaching. The entire space resulting from these conditions, where, as in the Herbert Hospital, the height of the ward is 14 feet, may, according to some authorities, be allowed to range so low as 1260 cubic feet.

(*n*) Trust for pavilion ventilation to open windows and fire-place. Artificial methods are in this climate unnecessary, with proper construction.

(*o*) Place water-closets, ward-baths, and lavatories at the far end of a ward, opposite the entrance; and, in addition to ventilating them, cut them entirely off from the ward by a separately-ventilated and lighted lobby.

(*p*) Restrict the ward-offices to a nurse's room and scullery, with a lift.

(*q*) Let staircases be wide, roomy, and thoroughly ventilated up to the roof. Construct the stairs and entrance and entrance-lobbies of stone, and cover them with wood.

(*r*) Make hospital floors of oak, and the walls and ceilings of pure white polished cement.

(*s*) Supply hospitals with water at high pressure, and lay it on, hot and cold, over the whole of the buildings.

(*t*) All sewers and drains must be outside, and detached from the walls of the buildings. Provide for their ventilation at a distance from the wards, and also for their inspection and flushing.

(*u*) Provide garden ground for exercise, with properly drained and gravelled walks, sheltered seats for convalescents, and, where practicable, a promenade covered with glass, for bad weather.

(*v*) Other matters of detail, regarding kitchens, wash-houses, rooms for hospital administration, etc., can be best decided on according to local circumstances; but none of these should ever be under the same roof with the sick.

25. Starting with the principle that the very first requirement in an hospital is that it should do the sick no harm, Miss Nightingale states that the conditions essential to the health of hospitals are principally these: first, fresh air; second, light; third, atmosphere; fourth, subdivision of sick into separate buildings or pavilions. Let us examine the causes in the usual ward construction which prevent us from obtaining these and other necessary conditions. The principal are as follows:—

(*a*) Defective means of natural ventilation and warming.

(*b*) Defective height of wards.

(*c*) Excessive width of wards between the opposite windows. The width of the wards in the Herbert Hospital is 26 feet; that in St. Thomas's 28 feet; in the new Hôtel-Dieu 29 feet; the two last-named being, however, great medical schools.

(*d*) Arranging the beds along the dead walls.

(*e*) Having more than two rows of beds between the opposite windows.

(*f*) Having windows only on one side, or having a closed corridor connecting the wards.

(*g*) Using absorbent materials for walls and ceilings, and, as some will have it, washing floors of hospitals.

(*h*) Defective condition of water-closets.

(*i*) Defective ward furniture.

(*j*) Defective accommodation for nursing and discipline.

(*k*) Defective hospital kitchens.

(*l*) Defective hospital laundries.

(*m*) Selection of bad sites and bad local climates for hospitals.

(*n*) Defects of sewerage.

(*o*) Construction of hospitals without free circulation of external air.

26. The most approved observations and experiences have sufficiently demonstrated that one floor is enough for convenience of the sick and for purposes of attendance, and that more than two floors will generally prove prejudicial in many important ways. The principles of construction which apply in the climates of Europe are generally suitable to those of India. But I believe that one-storied hospitals, built on arches, and having double roofs, will be found best for the plains of Hindustan, while the huts of the country, or iron huts having the country thatched roofs, will prove more convenient and useful for the mountain climates, besides being, out of all comparison, less costly.

27. In our garrison and regimental hospitals at home we generally find an extraordinary number of wards, and of holes and corners, in comparison with the number of sick. In a battalion hospital, for instance, we shall find eight or ten little bed-rooms (miscalled wards), a little kitchen; everything, in fact, on a little scale, like a collapsed French hospital. How much more sensible would it be to have one, or at most two, large wards for thirty to forty sick each, with a small casualty ward; how much less costly in construction and administration, how much easier the supervision and discipline, how much better the ventilation.

28. "The least administrative form of hospital," says Miss Nightingale, "is the long corridor, with wards of from eight to ten patients, opening off one side. Attendance—meaning, of course, due attention to the patients, suitably superintended—becomes almost impossible, especially at night."

29. Whatever the cause of injury to the sick or wounded placed in hospital, the truth and value of the following observation, by the same authority, will be recognized by all who are acquainted with hospitals, whether civil or military: "One insensibly allies together restlessness, languor, feverishness, and general malaise, with closeness of wards, defective ventilation, defective structure, bad architecture and administrative arrangements, until it is impossible to resist the conviction that the sick are suffering from something quite other than the disease inscribed on their bed-ticket; and inquiry insensibly arises in the mind—what can be the cause? . . . I have seen a case of slight fever received into hospital; the fever to pass off in a week, and yet the patient, from the foul state of the wards, not restored to health at the end of eight weeks."

30. "It is impossible to ventilate a ward in a brick or stone hospital by natural means, when the cubic space is less than a certain amount. Crowded wards are, in fact, offensive with all the windows open."

31. "The cooking apparatus, boilers, etc., if placed in the centre of the kitchen, instead of against the walls, will afford twice the amount of fire-space."

32. "In the Paris kitchens there is a brick erection in the middle of the floor, with iron doors and brass mountings, coppers with covers, places for baking and roasting, etc."

33. "The dressers are against the walls; the floors are flagged with square flags. This appears to be the most convenient mode of erection."

37. "But it is not so well known that there was but lately scarcely an army hospital which had such a thing as a laundry. The bedding was generally washed by the barrack department; no one appeared to know how. It was done by contract."

39. "A great deal has been said about the communication of 'infectious' disease, both in civil and military hospitals, from patients' linen to washerwomen. . . . Let laundries be constructed with sufficient area and cubic space for each washer, with abundance of water, with proper means of drainage, and ventilation for removing the vapor, and with properly constructed drying and ironing-rooms, and we shall cease to hear of washerwomen 'catching fever.'"

40 "But every day brings in fresh inventions, and the reformer is always adopting the good ones. The excellent washing, drying, and wringing machines lately invented are too numerous to mention; but, on the whole, the laundry at Wellington Barracks, which also washes for all the Guards' hospitals and barracks, and the new laundry at Haslar Hospital, are the best I have seen."

41. "I do not think that any reliable comparison has yet been made between the French system adopted at the Salpêtrière and Lariboisière hospitals and the English system. The French consists in filtering hot lye through the clothes, which are placed for that purpose in large tubs, with a compartment at the bottom from which the lye is pumped up by machinery, and allowed to flow over the top to the linen, through which it filters into the

compartment, to be again raised by the machine. This plan is stated to be the most economical which has been tried in Paris."

42. "There are several good plans in use in British hospitals. The essential characteristic of the Haslar one is boiling by steam, the linen being afterwards placed in a rotating washing machine."

43. "Another method in use at the Wellington-barracks, where the washing of the Guards' barracks and hospital is done, consists in passing the linen through slowly rotating washing-tubs, in which it undergoes a process of *waulking* by wooden rods. This plan is both economical and effectual."

44. "In almost all the military hospitals in England, it is true, the heavy washing is done, nobody knows how, by contract. But the lighter washing is done in some miserable lean-to, without any arrangement for 'getting-up,' drying, or airing the linen, which is done, if at all, at the ward fire. This is simply destruction to anything which can be called nursing."

45. "The baths should be separated from the pavilions, but connected by the corridor."

48. "A small bath room for bad cases should be placed adjoining to the water-closets, and also a lavatory."

49. "A lavatory should have a row of white earthenware basins fixed in a stand, with outlet tubes and plugs; each basin should have a hot- and cold-water pipe, and there should not be less than one to each six or eight beds. There should also be in the lavatory a hot- and cold-water pipe, from which the portable bath can be filled."

50. "A scullery—small, but not too small—attached to each ward is, as has been said, essential to order, cleanliness, and discipline. It should be well provided with cold, and if possible, with hot water. No patient should enter the scullery unless sent there to wash up, etc.; and, as a rule, none should be sent there."

51. "The sink, which should have a partition of its own, adjoining the water-closet, should be a high, deep, large, round, pierced basin of earthenware, above a large hole, with a cock extending far enough over the sink for the stream of water to fall directly into the vessel to be cleansed. This is far preferable to the usual oblong sink."

52. "The scullery sink is of course to be entirely separate, and for entirely separate purposes from this."

53. "In civil hospitals, each nurse hould have a small airy room off her ward, and looking into it, so that she can always have it under her command: it is the best for her efficiency, and need not be injurious to her health."

54. "Unless, however, there are facile means of access to another nurse's room, in case of illness, there must be only a day-room for each head-nurse adjacent to her ward. She must sleep at a distance from her ward, and contiguous to the other nurses."

55. "Assistant female nurses are better not employed."

56. "In military hospitals, if orderlies are to sleep among their patients, the percentage of mortality will be of course raised among them. This was the case at Scutari, where it was very high, though it will never be known how high."

57. "Statistics are, however, not necessary to establish such an obvious fact. The orderlies should keep at a distance from the wards, or, if sanctioned by military authority, in little rooms adjoining their wards, and they should not take their meals with the patients."

58. "Each orderly should have his locker, each his safe in it, with a key of his own, and he should have his meals there, if the military authorities are not against it."

59. "There should be a press in each ward."

60. "It is a doubtful arrangement to have a clothes-room for each ward. A military hospital should have but one clothes-room, under charge of some man."

61. "Room for storing and issuing dried clean linen, as well as laundry-room, should be provided. Foul linen should be delivered twice daily into the laundry; and a large box in the scullery is the least bad place for it in the mean time."

62. "The material of the different utensils required for ward service should be settled. The use of glass or earthenware for all eating, drinking, and washing vessels is recommended for its great superiority in cleanliness, and in saving time and labor in cleaning. Tin vessels of certain kinds cannot, by any amount of cleaning, be freed from smell."

63. Recent discussions have imparted much interest to the question of site, especially in connection with the wants of city populations.

(*a*) Could sanitary considerations alone rule in this matter, doubtless we should have all the hospitals placed in the open country, as near as might conveniently be to our towns and cities, but away from masses of buildings and from dense populations.

(*b*) But there are other considerations, as the immediate wants and conveniences, the absolute necessities, indeed, of the poor, which must here be practically met. We must, under such overruling influences, be content to do what can be done.

(c) All physicians and surgeons will agree that the more open, airy, and pure the site of an hospital, the better for its inmates; but here, as in many other social conditions, we have in fact to deal with the necessities of civilized communities, and we must have certain hospitals of immediate necessity placed within crowded cities.

(d) But while this fact is admitted, as the result of necessity, we ought everywhere to establish convalescent hospitals, supplementary to, and co-operative with, the central institutions.

(e) But we must remember also that in the perfection of structure, as regards facilities for ventilation and drainage, and in care as to the cubic space allotted to each patient, will everywhere be found the best securities against errors and deficiencies in respect of localities, whether in town or country.

(*f*) Strange to say, we have in the hospital Lariboisière an example of a structure of unequaled excellence, with a good town site, all rendered unsuitable, and consequently unhealthy, by a perversion of arrangement. Lariboisière was constructed for natural ventilation, but this was not deemed sufficient; so, pure air has been denied to the patients, and a heated and impure air has been forced into the wards to stifle and sicken them, and to augment their mortality.

(*g*) It is conduct such as this, in discharge of a public trust, which gives color to and occasion for the suggestion of Pouteau, above quoted: "Are hospitals, then, more pernicious than useful to society?"

(*h*) One circumstance has been much overlooked in discussions as to the construction of hospitals, and of their usefulness—namely, that the disadvantages of massing sick in very large apartments, however unsuitable on various accounts, and in many cases, bear no comparison with those which are always encountered in the miserable habitations of the poor, both in town and country;—the fact being that many of the defects in the worst hospitals may be in great part remedied by means of ventilation, and by providing day-wards, and by the establishment of convalescent hospitals.

Lastly. The convenience of the patient must be a point of first consideration, so as that the hospital may be completely accessible to the ailing, the diseased, and maimed amongst the poor; so as to secure also to them the services of physicians and surgeons in large private practice, thus assuring at the same time the best medical science from the heads of the profession, together with the best means for the establishment of great medical schools.

Postscript.—The idea of a perfect hospital would imply, generally, an elevated site and pure dry soil, the building being constructed on an open space, and consisting of one story placed on arches, so as to secure the free play of air between the ground-surface and the floor of the wards; but on low grounds, and in marshy countries, a second floor has its advantages, as affording a more healthy sleeping accommodation. In no country should an hospital exceed two stories.

It were a serious error, therefore, to suppose that an hospital could by itself be so constructed as to prove everywhere sufficient; structural perfection being in reality but one of the requirements of the case. There must be, in aid of structure, works of general and sub-soil drainage, a pure-water supply, and an improved agriculture. These considerations become of greatly increased force in tropical climates.

VENTILATION, LIGHT, AND CUBIC SPACE.

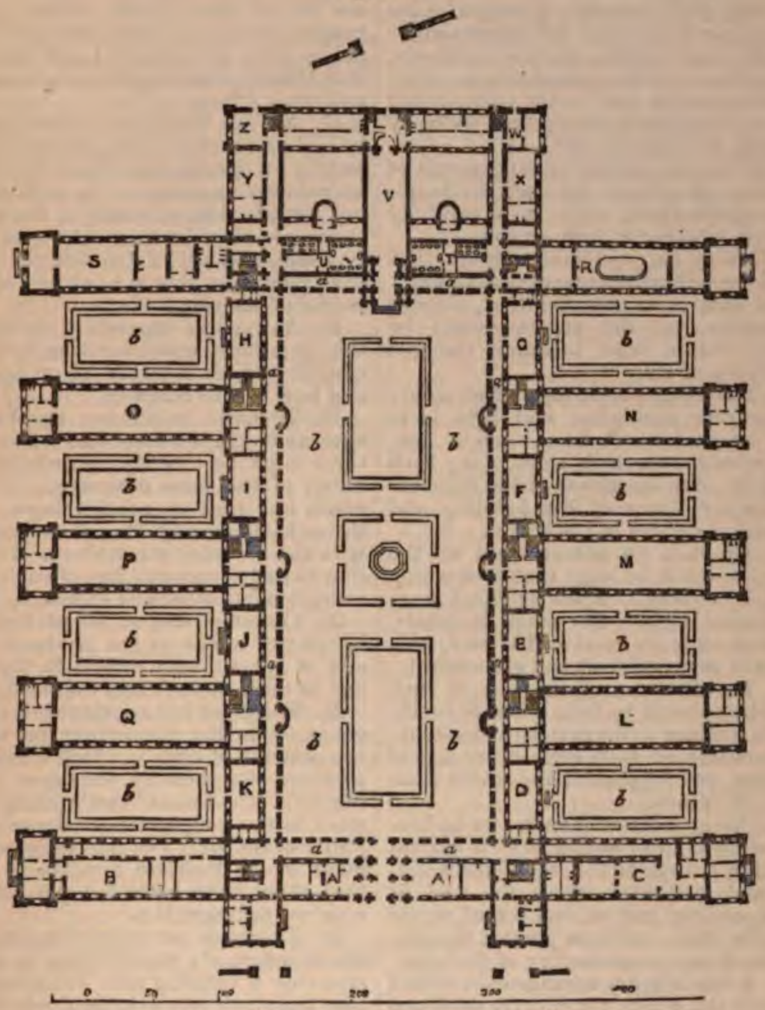
1. The first and most important consideration in constructing and arranging hospitals is to secure a free supply of pure air outside and inside the building.

2. The air must be moving air in mass. Plan the building, therefore, so as that the sun-light may strike as large a surface of it as possible, and so that the air may move freely over the whole external surface.

3. In Scripture the atmosphere is termed "the breath of life," as indicating the vital properties of pure air. So life-giving is pure air, indeed, that we must have it in excess of our actual wants, if we would insure that what we are inhaling may not be corrupted by the consumed air which we have exhaled; for be it remembered, that no kind of impurity of air is more injurious to health than the impurity of air expelled from the lungs. Ample cubic air-space is both important and necessary; but it alone will nowhere prove sufficient for health, without provision for the constant removal of the exhalations from the lungs and skin of the sick.

4. For thousands of years the natives of India have regarded purity of skin as obtainable only through the rinse of the river stream, or through the imitation of it in the bath-room by a constant stream of clear water poured from a vessel—the same water not applying to the skin twice. If we would enjoy a perfect respiration, with consequent purity of the

Fig. 978.



Hospital of Lariboisière, Paris, 612 beds.

- A Offices.
- B Kitchen on the ground floor. On the 1st floor, lodgings of the officers; on the 2d floor, dormitories for male attendants.
- C On the ground floor, pharmacy; on the 1st floor, lodgings of the officers; on the 2d floor, rooms of the resident pupils.
- D E F G H I J K Dining-rooms, etc., one story high, now disused as such.
- L M N O P Q Buildings for the sick, three stories high.
- R Ground floor, wash-house; on the 1st floor, linen store; 2d floor, dormitories for female attendants.
- S Sisters' rooms. T U Baths. V Chapel.
- X Y Amphitheatre.
- Z Manège and stores.
- W Stable and dead-house.
- *a a a a* Corridor one story high, with open terrace above, running round the buildings, and connecting them.
- *b b b* Gardens.

blood, we must secure the same kind of rinsing or cleansing, by a constantly succeeding supply of pure air for the supply of the lungs. In the eagerness of some persons to plunge into and appropriate all degrees of cubic space, they forget that the degree of purity of an apartment must depend not upon its size or space, in fact, but solely and exclusively—1st, on the rate at which emanations are produced; and 2dly, on the rate at which fresh air is admitted. Space is in truth of importance in so far as it admits of the introduction of air without the production of draughts, but even this advantage has its alloy in the difficulty of warming very spacious rooms. There must be supplied to every ward a means sufficient to warm the air to the proper degree.

5. The motion of the air in any room

should never exceed the velocity of two feet and a half per minute, and it should not at any time be much below this rate.

6. There must be no stagnation. A court, with high walls round it, does one thing with certainty—it stagnates the air, and renders it unfit for respiration.

7. All closed courts, narrow *culs-de-sac*, high adjacent walls, closed angles, overshadowing trees, and other obstructions to outer ventilation should be sedulously avoided, at whatever cost.

8. There are certain arrangements of buildings at present occupied for hospital purposes which ought to be carefully avoided, whether in town or country.

9. It may be considered certain, that wherever such arrangements exist, injury to the sick is so constant that, were it practicable, all the angles should be opened out, in order to admit the free circulation of air.

10. The most simple form of structure for insuring ventilation and light is to build hospital wards in a straight line, with windows on both sides, *i. e.*, back and front—the lengthway of the ward being the lengthway of the building, and the administration in the centre.

11. By such an arrangement as the above, however, no more than four wards could be obtained, if the building were two stories high. For small hospitals, intended only to receive 120 sick, this plan will prove efficient and economical.

12. The direction of the axis of such a building should be from north to south, a little inclined to the east, so as to secure the sunshine on both sides every day of the year, and to protect the wards from the N. E. winds.

13. One staircase will suffice for an hospital such as this; and if it were carried from the bottom to the top of the building, and ventilated above the roof, it would entirely cut off one set of wards from the other, and thus prevent the possibility of any intermingling of foul air.

14. A much better arrangement is that in which the wings are entirely detached from the centre, and connected with it only by an open corridor on the lower floor. This is the plan adopted in the great military hospital at Vincennes, and is a very good one for hospitals of a certain size, for the open angles permit air to circulate freely round the building. All these plans, however, have the disadvantage of not admitting extension beyond a certain limit.

15. The only plan which allows as much extension as can be necessary in any single hospital, up to (say) a thousand sick—beyond which hospital management becomes very difficult—is the plan adopted in the hospital of Bourdeaux; or, still better, that of the Lariboisière at Paris, of which the plan will be found on the preceding page.

16. In that fine, though not perfect, hospital, each block, containing 102 sick, constitutes a separate hospital. There are six of these blocks, which are arranged parallel to each other on two opposite sides of a square; and there are four blocks containing the administration and other offices.

17. All the blocks are joined together by a glazed corridor along the lower floor, and by an open terrace above, for convalescents taking exercise. In such a building, for the sake of sunlight, the axis of the wards should run nearly from north to south, and the distance of the blocks from each other should be about twice the height of the side walls.

18. As regards immediate ventilation, the important considerations are—the quantity of air required in an hospital, and how best to renew it.

19. To make ventilation equable and agreeable, the windows and other apertures must be directly opposite to each other, of the same dimensions, so as to admit and emit an equal volume of air, through an equally free communication with the external atmosphere. Inattention to this simple rule has often defeated arrangements otherwise excellent.

20. Oil-lamps are to be preferred for lighting of wards, as gas produces glare, and is apt, through defects in the pipes and burners, to leak into the ward.

21. The great and constant movements going on in the atmosphere prove that the amount of change which nature has provided for healthy existence is unlimited. The test of ventilation in a sick ward is the comparative freshness or impurity of the air. The interesting experiment of Lariboisière appears to prove that about 4,000 cubic feet per hour are required to insure this.

22. There are two ways of maintaining the freshness of a ward: First, by so constructing a building that Nature will renew the air, if left to herself, which is by far the best plan; secondly, by artificial ventilation—never to be used except as a *pis aller*.

23. If an hospital be badly planned, or the fuel dear, artificial ventilation comes into beneficial operation, for it admits of economical warming; but it never *freshens* a ward like pure natural air from without.

24. It is quite certain that a condition of ward-air is secured by open windows, and by open fire-places for warming, which is never obtained by the best ventilating machinery, especially if warm air be thrown in by it. Every observant medical officer and nurse knows this: the air from without is better oxygenated, and perhaps contains more ozone.

25. Architects must therefore well consider how in every corner of wards, passages, and staircases, air is to be kept constantly *flowing*—not air passing in a stray or in a strong current, but air gently moving.

26. Wards must be made of a certain height and breadth, having a window for every two beds, the windows being exactly opposite to each other. As regards complete ventilation, the effect of angles in retarding an even flow of air has not been sufficiently considered. Direct experiment, made in the wards of the Lariboisière, has proved that the amount of air circulating along the centre of a ward is two or three times as great as near angles.

27. Such a result might have been inferred. But the important practical point seems never to have been comprehended, that the difficulty of ventilating a given cubic space, occupied by sick, bears a direct ratio to the length of the corridor, and to the number of wards into which that space is divided.

28. Unnecessary rooms, angles, or cupboards, should be omitted; there should be no dark corners in any part of an hospital ward; every recess or angle not easily overlooked, being as injurious to hospital discipline as it is to hospital ventilation. Transverse or horizontal ventilation may be rendered perfect by the means already indicated; but in seasons of protracted calms, in the heat of summer and autumn, and in tropical climates, means should be prepared for securing vertical ventilation, by means of turrets in the roofs of hospitals and barracks.

29. Each pavilion should have a staircase, wide, roomy, well lighted and ventilated from above; the gradients of the steps not rising above five inches to twelve inches tread, in order that patients may ascend and descend with facility.

20. There should be as little passage-space as possible, and none of it should be dark.

31. Architects have not sufficiently appreciated the great difference between the air-wants of wards constantly occupied by sick and wounded, and those of apartments used as dormitories during so many hours only, by persons in health, and that a provision which may be sufficient for the one falls far short of the necessities of the other.

32. Mr. Roberton, of Manchester, in his excellent reports on the "Construction and Ventilation of Hospitals," assures us that the insalubrity of our hospitals arises mainly from two causes; first, the difficulty, owing to faulty construction, of securing a free circulation through the wards, and continued renewal therein of the external atmosphere; and secondly, the intimate connection existing between the different wards in each story, by means of doors and passages, and between the different stories by inside stairs — an arrangement which favors the rapid diffusion over the house of the foul air continually being generated in every one of the wards, and the creation consequently of an hospital miasm.

33. But all the evils of defective ventilation were well known to our older hospital staff, civil and military, and are admirably described by Pringle, Cullen, Lind, Rush, Robert Jackson, Smith, etc.

34. In remarks concerning circumstances of distress not within the provisions of hospitals, with the regulations of the Samaritan Society, instituted in London in 1791, we find the following observations:—

35. "The air may have its purity, and consequently its uses, affected in several ways; by what diminishes its immediate fitness for respiration; by what lessens its capacity to receive in due quantity that which is excreted from the lungs and skin; by what destroys, or abridges, that which should be received by the absorbents of the lungs and skin; and by what, in its own nature, would prove noxious, if absorbed. In these ways also various combinations of mischief may arise."

36. "To the last distinction animal effluvia must be referred. But infinite are the depravations of the air, under the heads stated, graduating from the slightest degree of each, up to the power of producing death instantaneously."

37. "Attention being paid to the cardinal object, AIR, hospitals possess advantages, adapted to the condition of sick and hurt persons, superior to what can be equalled by many situations in life. Informed persons should, therefore, discourage the prejudices that are sometimes entertained by the lower orders against these establishments; in support of which they will not unfrequently resort to invention."

38. Dr. Percival, of Manchester, writing to Mr. Aikin, in 1771, says: "AIR, DIET, AND MEDICINE, are the three great agents to be employed in preventing and correcting putrefaction and contagion in hospitals." There he rates medicine as the third power.

39. Pringle declares that "air corrupted by putrefaction is, of all other causes of sickness, the most fatal, and least understood; for these destructive steams work like a ferment, and ripen all distempers into a putrid and malignant nature. But the air in hospitals and crowded barracks, close transport-ships, and in a word, from every place where air is so pent up, not only loses a part of its vital

principle by frequent respiration, but also is corrupted by the perishable matter of the body, which, as it is the most volatile part of the humors, is also the most putrescent; hence it is that, in proportion to the nastiness of such places, to the number of dysenteries, and of foul sores, but above all, of mortifications, a malignant fever is both frequent and fatal."

40. The instructions of Donald Monro, the army surgeon, for the ventilation, cleanliness, and order of the military hospitals of his day (1760-1780), would do honor to any medical officer of our time; and Brocklesby (1756-1763), speaking of his experience in preserving the health of seamen and soldiers, distinguishes "above all things fresh air."

41. As regards the general principles, and the need for ventilation, there is nothing whatever known to us, in the middle of the nineteenth century, which was not well understood by Pringle, Monro, and Brocklesby, in the middle of the eighteenth century. The real difference in our favor is in the aid we derive, practically, from the influence of public opinion, and from the power of the press which represents it.

42. Dr. Rollo, of the Artillery, states (1801) the following points as necessary in an hospital:—

(1) A free ventilation and regular temperature.

(2) Ready means of cleanliness.

(3) Amusements for patients, by giving them airy and gay prospects, with pleasure-grounds.

(4) A ready means for separation of the sick, and for preventing the spreading of progress of infectious diseases.

He adds that "cleanliness of the patient, and of everything about him, is indispensable. This and ventilation are the two first and most essential objects in hospital management."

43. To illustrate his subject, Dr. Rollo says that, in 1789, several men of the artillery at Woolwich were seized with a severe form of continued and relapsing fever. These men were found to have occupied beds "different from the rest of the barracks, having hammock-bedding. The hammocks were rolled up tightly every morning the moment the men rose, and they were unloosed when they went into them at night; and this time we had so much and so constant rain, that this bedding had not been aired, or opened for a single day, for at least two months. The hammocks were with their bedding examined, and the moment they were opened a very peculiar nauseating smell was perceptible. Steps were immediately taken, and no further mischief took place. Here an infectious fever evidently arose from the confinement of the effluvia of a man's own person, in a time of about two months."

44. Having explained thus far the principles and practice of ventilation as applicable to hospitals, I would add a few observations on LIGHT—a subject of the greatest importance, but one surprisingly neglected by all classes of our teachers, whether lay or professional.

45. Of all the elements which play a high part in the material universe, the light which emanates from the sun is certainly the most remarkable, whether we view it in its sanitary or scientific relations. It is, to speak metaphorically, the very life-blood of nature, without which everything material would fade and perish.

46. "It is well known," says Dr. Priestley, "that *without light* no plant can thrive; and if it do grow at all in the dark, it is always *white*, and in all other respects in a sick and weakly state."

47. But the direct influence of light over the phenomena of life will not be found limited to the vegetable kingdom, or to the lower races of the animal world. Organization and life exist only at the surface of our planet, and under the influence of light. Vegetables and animals near the surface of the sea are brilliantly colored; but they gradually lose the brightness of their hue as they descend, until the animals of the lowest zone are found to be nearly colorless. Those depths of the ocean at which an everlasting darkness prevails are the regions of silence and eternal death.

48. Man in his most perfect type is doubtless to be found in the regions of the globe where the solar influences of light, heat, and chemical rays are so nicely balanced. Under the scorching heat of the tropics man cannot call into exercise his highest powers. The calorific rays are all-powerful there, and lassitude of body and immaturity of mind are its necessary results; while in the darkness of the Polar regions the distinctive characters of our species almost disappear, in the absence of those solar influences which are so powerful in the organic world.

49. Dr. Edwards maintains, however, that in climates in which nudity is not incompatible with health the exposure of the whole surface of the body to light will be very favorable to the regular conformation of the body; and Baron Humboldt affirms of the Chagmas that "both men and women are very muscular; their forms are fleshy and rounded. It is needless to add that I have not seen *a single individual with a natural deformity*. I can say the same of thousands of Caribs, Muyscas, and Mexican and Peruvian Indians, whom we have observed during

five years. Deformities and deviations are exceedingly rare in certain races of men, especially those who have the skin strongly colored." The development of the perfect form of certain of the lower animals, it is well known, depends on light.

50. The influence of the sun's rays in deepening the color, or in giving a brown tint to the skin, seems to be more due to the light than to the heat of the sunbeams; for the parts of the skin covered by the clothes, though kept thus hotter than the parts exposed, do not undergo this change.

51. The pale visage and enfeebled vitality of those who live much in obscure apartments, in prisons, and in mines, are well known; and though probably the most violent symptoms that characterize the anæmia of miners, in which the skin assumes a yellowish waxy hue and the lips become bloodless, may be chiefly due to breathing a vitiated atmosphere, yet some influence is certainly attributable to want of light. The anæmia of persons long confined in dungeons has often been remarked, and was lately described as strikingly exemplified in the person of Caspar Hauser, the young man whose mysterious birth, confinement, and assassination have hitherto baffled conjecture.

52. But, recurring to the influence of the sun's rays on growth, "we see," says Dr. Edwards, "that the action of light tends to *develop the different parts of the body in that just proportion* which characterizes the type of the species. This type is well characterized only in the adult. The deviations from it are the more strongly marked, the nearer the animal is to the period of birth."

53. If light thus develops, in certain races, the perfect type of the adult who has grown up under its influence, we can hardly avoid the conclusion drawn by Dr. Edwards, "that the want of sufficient light must constitute one of the external causes which produce those deviations in form in children affected with scrofula;" and the more so, that this disease has been observed to be most prevalent in poor children living in confined and dark streets. Following out the same principle, this distinguished physiologist infers that, in cases where those deformities do not appear incurable, exposure to the sun in the open air is one of the means tending to restore a good conformation.

54. If the light of day, then, freely admitted into our apartments, is essential to the development of the human frame, physical and mental; and if the same blessed element lends its aid to art and nature in the cure of disease, it becomes a personal and a national duty to contruct our dwelling-houses, our schools, our workhouses, our churches, our villages and our cities upon such principles, and in such styles of architecture as will allow the life-giving element to have the fullest and freest ingress, and to chase from every crypt and cell and corner the elements of uncleanness and corruption which have a vested interest in darkness.

55. If it is important to obtain a proper illumination of our apartments when the sun is above the horizon, it is doubly important when he has left us altogether to a short-lived twilight, or consigned us to the tender mercies of the moon. In the one case it is chiefly in ill-constructed dwelling-houses and large towns and cities, where a dense population, crowded into a limited area, occupy streets and lanes in almost absolute darkness, that science is called upon for her aid; but in the other we demand from her the best system of artificial illumination, under which we must spend one-third of our lives, whether they are passed in the cottage or in the palace, in the open village or in the crowded city.

56. As regards the lighting of hospitals, window-blinds can always moderate the light of a well-lighted ward; but the gloom of a dark ward is irremediable. We can generate warmth, but we cannot generate daylight or the purifying and curative effects of the sun's rays.

57. Dark barracks and barrack-rooms, with northern aspects, it is well known, will furnish a larger amount of sickness than light and sunny rooms.

58. The danger of thorough ventilation is much exaggerated, for, excepting in a few well-known instances, the risks are hardly worth estimating, as compared to the benefits of the life-spring to the sick—fresh air. Patients in bed are not generally inclined to catch cold.

59. Catching cold while in bed follows the same rule as while we are up. If the atmosphere be foul, with the lungs and skin oppressed, and unable to relieve the skin by depuration, then a draught may bring a chill; but this is the fault of the foul air, not of the fresh.

60. As regards temperature, trifling variations are in general rather beneficial than otherwise, and a cooler atmosphere at night acts rather as a tonic.

61. It is much to be regretted that of the influence of light upon the human frame and upon the mind in health and disease, so little should be known to us; but let us hope that physicians and physiologists may be induced, by the importance of the subject, to avail themselves of their numerous opportunities in hospitals, prisons, and asylums to study this great subject.

62. Our hospital architects in England

do their best to shut out our rare and imperfect sunlight, and to keep pure air out of the wards as much as possible; while they provide for the sick being so arranged that the effluvium must pass over a succession of beds before it can escape.

Postcript.—Having presented to the reader an exposition of natural ventilation as arranged in the modern French hospitals, I will briefly state the plan and object of the late Mr. Mackinnel's invention; for it also purports to ventilate all kinds of buildings and all kinds of apartments through an entirely natural process, and by means, indeed, of a law of nature.

(*a*) This latter plan is recommended to us on the score of its simplicity and ready applicability to all kinds of areas, whether opening to the atmosphere vertically by the roof, or only horizontally by the external walls, and by the manner in which it equalizes the waste and repair, without ever allowing the air to become deteriorated, or to be thrown into commotion by contending currents.

(*b*) The apparatus consists essentially of two tubes, the one placed within the other, with an annular space between them, and both opening freely into the external air. The internal tube, destined to carry off the vitiated air, is placed in the chamber to be ventilated, with its downward opening near the ceiling, towards which the air, from its superior lightness, naturally ascends.

(*c*) The annular space is intended to supply the waste, and accordingly the external air, which is denser and heavier than the vitiated air, naturally passes through it into the chamber.

(*d*) Were it left free, it would form an injurious descending current; but this is ingeniously obviated by a projecting flange, which, checking the entering air in its downward course, causes it to spread equally and horizontally over the whole area, without producing any of those sudden fluctuations of temperature, which, in other modes of ventilation, have been felt at once unpleasant and unsafe.

(*e*) Over the escape-tube there is placed a hood, so contrived as to prevent the admission of rain. This tube would be sufficient to allow all the foul air of a room to escape from it; and if doors and windows were kept open, there would be a constant supply of pure air.

(*f*) Draughts have to be avoided in any efficient scheme of ventilation, otherwise it would be an evil in place of the greatest good; but Mr. Mackinnel has a simple and effective method of supplying fresh and pure air, while he takes off that which has been consumed and corrupted.

(*g*) Attached to the outer tu
which envelops, so to speak, t
tube, he has an arm or arms
at right angles, or by any ot
nient direction, to the outer
while the inner tube is causi
ward and outward current, t
lead the exterior and pure ai
concentric opening formed be
two tubes, where there is a cons
ward current.

(*h*) The flange already spoken
the air in a thin film across the
the apartment, whence it falls,
quence of its greater gravity,
ceptible columns, like rain, dow
the body of air in the chamber.

(*i*) The whole aim of this
is to give concentrated play an
the natural action; and in t
seems completely to succeed,
tube drawing off like a chimn
foul and heated air within, and
tube, with the air-ducts passi
at right angles to the outer at
affording a passage to the pure
flows to the vacuum thus creat

(*j*) Such is the simple, safe,
tific means of the inventor fo
ply of an effective ventilation
description of building. It is
natural in its action, in whic
ceive an absence of everythin
ing. On the contrary, fresh
introduced in a natural and im
manner, and distributed over a
as not to offend the most delica
skin.

(*k*) While it has always be
easy matter to produce stron
of air, it has hitherto been f
difficult to devise means by
tiated air should have an eas
tain escape, while the pure
find an equally ready means of
the egress and ingress being
yet so constant and impercepti
to indicate any remarkable at
action.

(*l*) This practical efficiency
tion appears to have been brou
by Mr. Mackinnel in an easy
manner, capable now of being
by the rigorous test of the resu

(*m*) All descriptions of buil
vate and public, have been sup
this apparatus, and always wit
results, as evidenced by num
unquestioned testimonies.

(*n*) The scheme aims at t
ment of its object by aid of
law; and with its good prope
not hitherto been found to
evils, which is saying much f
ventor.

(*o*) In Merchant's Hall, Glas
so full that nearly a thousan

were assembled in it, two ventilators were found, in mid-winter, "amply sufficient to keep the air sweet and wholesome," the doors and windows being meanwhile kept closed.

(*p*) "Such was their efficacy, that no perceptible change could be discovered between the air in the hall, when full of people, and when it was emptied."

(*q*) So, also, when applied to stables and a veterinary hospital, the air was fresh and free from all offensive and ammoniacal gases; while the horses were observed to recover from their respective diseases much more speedily and effectually than before.

(*r*) One peculiarity of Mr. Mackinnel's system remains to be noticed. It will not act, and there is no need for its action, in empty apartments having the temperature of the air inside of the same scale with the outer atmosphere. But when, in an occupied area, through the ascent of the warmer and lighter air consumed in expiration, the inside temperature becomes raised above that outside; then the processes of escape and admission begin; and they both proceed in exact and regular proportion—the one rushing out, and the other pouring and spreading inward, after the gradual and imperceptible manner already described, and as regulated by the demand for pure air of the area inhabited. To ventilate the corners of apartments, excepting by some such action as this, would appear next to impossible, through natural means.

Finally, the task to be performed is this: to ventilate all kinds of apartments, and enable the inmates to receive the amount of air requisite for health, thus counteracting all kinds of structural defects in private and public buildings. If Mr. Mackinnel can do this, and he appears to have done it, he will indeed have achieved a great victory, and conferred a benefit on the public beyond estimation. If his system can do all this, it fulfils the most important purposes. It corrects the hitherto irremediable errors of structure in our barracks and hospitals—errors not to be corrected in any other way except by rebuiding; it renders barrack-rooms and wards of hospitals habitable which were before not habitable.

I hope that the foregoing remarks on the ventilation of hospitals may not be regarded by the reader as too long or too minute in their details. The subject is of the last importance, and the profession in a general way knows its importance. But there is a vast difference between the general perception of a fact and the actual realization of its import; and this is my excuse for the length of the present section.

There are many important objects interesting to society which present themselves in contemplating the construction and the professional concerns of hospitals; and, as in commercial and other affairs of life, they will best be understood by men who have most directed their attention to the subject.

Since the above was written, an improvement upon all hospitals hitherto constructed has been made in our own country; and I cannot do better than present the brief statement of its advantages from the authority so often quoted in this essay.

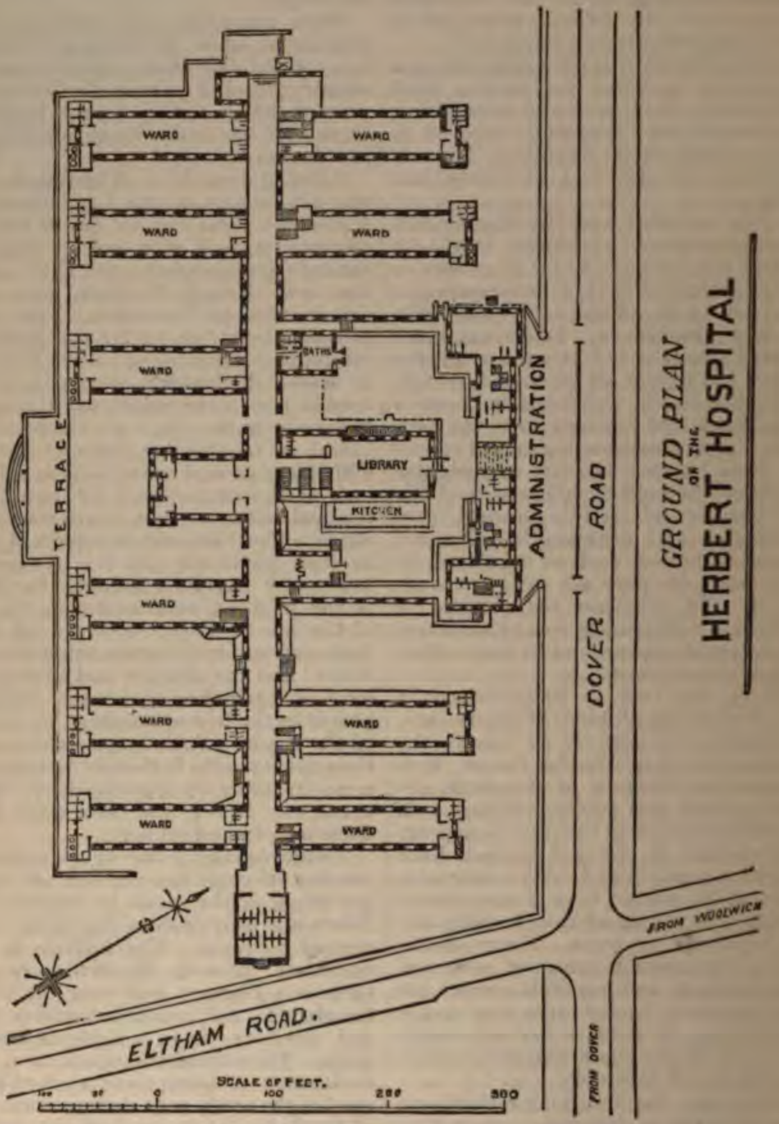
"But," says Miss Nightingale, "all the advantages of the Lariboisière and Vincennes plans without any of their disadvantages, and with greatly improved sanitary arrangements, will be realized in the new Herbert Hospital, now under construction at Woolwich. This, when completed, will be by far the finest hospital-architecture in the United Kingdom, or indeed in Europe. It consists of four double and three single pavilions, with the ends in the air. All the wards are raised on basements; those at the lower end of the ground are so lofty as to afford excellent accommodation for the museum, medical officer's room, board-rooms, and stores. There are only two floors of wards to each pavilion; and the distance between the pavilions is double the height of the pavilion, measured from the floor of the lowest ward. Every ward has a large end-window, commanding beautiful views; and the ablution and bath accommodation, together with water-closets, is placed in the free atmosphere at the end of the wards. Each large ward contains from twenty-eight to thirty-two beds, with windows along the opposite sides—one for every two beds; and each ward has a nurse's room and scullery.

"Unfortunately, the army regulation number of cubic feet per bed has limited the height of the wards to fourteen feet. There is a convalescent day-room in the central pavilion. The kitchen is in a basement; also in the centre over it, there is a library; and over the library the chapel. All the administrative offices and quarters are in a separate block in front. The axis of the wards is a little to the east of north; and each side will receive the sun's rays during some part of the day. At one end of the hospital there are separate lunatic wards, with separate offices. At the other end is the operation-theatre, with a few small wards for special cases.

"The total accommodation is for 650 beds, in seven detached buildings, all connected together through the centre by a corridor one floor in height, with a basement corridor beneath, through which the whole service of the hospital, so far as regards the conveyance of diets, medicines, coals, and the removal of dust and foul linen, will be carried out. This is effected by a system of lifts and shoots; and the result will be, that the usual bustle observed in hospital passages will be altogether avoided.

"This hospital embodies the great administrative principle of an entire separation between what is immediately necessary for the sick and what is not so, and yet without interfering with the efficiency of the administration. Over the corridor is an open terrace, to which convalescents in the first-floor wards will have easy access in fine weather; and the covered corridor below will be available for exercise in wet weather.

Fig. 979.



"Each ward is 26½ feet wide and 14 feet high; and each bed has 93 to 97 superficial feet, and 1200 to 1400 cubic feet. The wall will have a polished light-colored surface. It is intended to warm the wards by two open fire-places along the centre of the wards, the flues being carried under the floor, and used for warming the air admitted to the wards. The floors are of iron beams, filled in with concrete, and covered with oak boarding. The whole will be fire-proof, and the sick in the lower wards will not suffer from noise in the wards overhead. Hot and cold water will be laid over the entire building; and the water supply, which is taken from chalk, and hard, will be softened by the lime process before being transmitted to the hospital."

Hygiene of Hospitals.

The hygiene of hospitals comprises the proper selection of localities, attention to suitable construction, ventilation, admission of light, supply of pure water, with means of flushing drains and sewers, proper diet and clothing, a just distribution of sick, personal hygiene, and personal attendance, etc.; in short, attention to all those well-known measures of prevention of disease, and of aids to cure, the suggestions of experience in hospital management, with which physicians and surgeons are now happily becoming better acquainted than was formerly the case.

2. Medicine has during long ages been in an unnatural condition of reversal or of transposition; and hence the art of healing has been more present to the minds of the professors of physic, and of the public consequently, than the science of hygiene. So highly, however, has hospital hygiene been appreciated in France for some time past, that hospital construction has there recently attained nearly to perfection. We are now following the good example, and may soon hope to equal, if not surpass, our neighbors.

3. Surgeons, too, while they have so frequently disputed about modes of performing surgical operations, have but seldom occupied themselves with an investigation of the causes of surgical fevers and other hospital diseases, producing annually, before and after surgical operaions, so large a mortality in our charitable institutions. The supply of pure air, nside and outside the hospital, with a arge supply of pure water for inside and outside purposes, will go far to prevent ll such diseases.

4. The prevalence of surgical, puerpeal, typhus, or typhoid fevers; erysipelas, yæmia, sloughing, or profuse suppuraions in wounds or ulcers, may everywhere be regarded as a sure proof of ill-construction, defective ventilation, and of insufficient personal hygiene in hospitals; while the rapid healing of wounds and sores, the absence of erysipelas and low evers, may, on the contrary, be received as indices of excellence of plan, arrangement, and discipline.[1]

5. Every patient who is placed on the operating-table incurs a certain amount of risk of death; but when the operation is severe, and the hygienic conditions unfavorable, the risk incurred is as great, or even greater, than that incurred in severe military enterprises, as battles and sieges. How careful and continual should therefore be our endeavors to secure the sanitary integrity of our hospitals, so as thus to aid by our best means the efforts of the physician and surgeon.

6. Miss Nightingale, referring to the organization for sanitary purposes, government, and supply in hospitals, says: "The first is really the most important. The sick at Scutari might have been loaded with medical comforts, attended by the first medical men of the age; and under sanitary conditions such as there existed, they had not a chance."

7. Referring again to the hygiene of hospitals, civil and military, the same authority adds: "The distinction between personal and public hygiene must not be overlooked. It is acknowledged in civil life. The officer of health of towns," who was first proposed by Mr. J. R. Martin, "does not do the work of the physician or surgeon; and on the other hand, you do not send for your physician or surgeon to drain your streets."

8. "Had an officer of health," as proposed again by Mr. Martin, "been attached to the quarter-master-general's department at the base of operations, who would have put to rights those buildings before we occupied them, how much life would have been spared!"

9. "This officer should have full powers, through the quarter-master-general's department, to see, 1. to the draining of sites; 2. to the sewerage; 3. to the cleansing of outskirts; 4. to ventilation; 5. to water-supply; 6. to lime-washing and cleanliness of the buildings; 7. to the allotment of cubic space; 8. to the sanitary conduct of burials;" and so also in civil life.

10. "There is here quite enough for one man to do. There is no more need for this administration of hygiene of buildings to clash with that of the personal hygiene of the patients, which must always be left to the medical officers, than in the precisely analogous case of civil

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[1] The bedding and bed-clothes should be carefully ventilated, as often as may be practicable, in the open air and sun's influence; otherwise, in apartments having heated air. This is a duty of the utmost importance in times of dangerous diseases, endemic or epidemic.

life, where no man ever thinks of confounding the two."

11. "Before and after the works executed by the Sanitary Commissioners, begun in March, 1855, the hospitals at Scutari bore a similar sanitary difference to that which the gaols of the last century, which were pest-houses, did to Colonel Jebb's prisons of 1857, the most healthy buildings in existence."

12. "The sanitary works were begun, and, after their completion, the mortality fell to less than one-sixth of what it was when the barrack and general hospitals were first occupied together, in October, 1854, and to one-nineteenth of what it was in February, 1855. What other inference can be drawn from such statistics and conditions but this, that, had nothing been done, before four weeks were out, or as soon as the hot weather set in to give fresh strength to the seeds of epidemic disease buried among us, the hospital population of the Bosphorus would have been swept from the face of the earth, and there would have been no one left in those lazar-houses to tell the tale! Civil life is full of similar lessons."

13. "I am bound to say that the military hospitals I have seen in England—Portsmouth, Chatham, Brompton—are almost as much in want of certain sanitary works as Scutari."

ADMINISTRATION.

Mr. Fonblanque observes, that "it is not the *personnel* but the *morale*, upon which a sound administrative system hinges; a system based on the personal integrity of its agents." The objects and ends to which everything in an hospital should tend, are—economy in expenditure, ease and expedition in labor, and exactness in the results. These great objects are attained by regulating the order of labor, by removing superfluous servants whose presence obstructs real labor, and by dispensing with useless labors which consume precious time, obstructing and postponing the results; by the establishment of a system, in fact, in which economy and humanity shall be equally respected. The success of the treatment of the sick in hospitals depends less on the remedial means than on the care, the vigilance, the regularity, and the order with which service is performed. Without that order, the sick run the greatest risks, even in the hands of the most able and the most practised.

2. By a perfect administration—by proportioning the number of trained servants to our wants—by regulating their various functions—by uniting economy with success, in fact—we may in some measure
overcome imperfections in
rangements. But, on the
when administration is ill-
the hospital building-ill con
death to the inmates. Bo
such overwhelming disadva
of our own creation—the hi
and the best exertions of t
and surgeon are set at noug

3. Having made ample
the admission of light, and
freedom of ventilation, our
rangements should, as stat
the greatest economy in ad
consistent with the rapid
wounds, and the perfect re
sick.

4. There should be facilit
tendence and nursing—the
of such a size, and so arran
head-nurse may have all h
her eye at once; this is esp
sary for night service.

5. A nurse may adequately
a ward of from thirty to fo
But, if we are to be guided
of recent experience in hospi
we should say that a ward
sick, or thereabouts, is, upo
the best for sanitary reasons

6. A convenient arrangem
and the laying of hot and
over the building, economize
certainly as much as one
every thirty sick.

7. Provided always, that
staff be well chosen, it may
hospitals, civil and military
regard the credit of the i
the welfare of its inmates,
interference—the more the e
trusted by the governing
better.

8. By the exhibition of
dence the governing body
the medical staff that ch
which has useful result for it
avoid that greatest curse
dling—a cold performance of
a wise course of treatment w
a cheerful system of subordi
progressive responsibility, w
no hospital, whether civil or
prosper. To unite men of lik
and pursuits, and make the
for the public good, is to turn
to the greatest advantage.

9. In all establishments
ment of the medical professi
held systematically in view
any medical officer forfeit t
of the governing authority,
once be withdrawn. There
to be any medium between c
the want of it.

10. Miss Nightingale—alw
est authority—gives the foll

in general terms, for the government and supply of a military general hospital :—

11. *Government.*—One executive responsible head is what is wanted in a military general hospital, call him governor, commandant, surgeon-in-chief, or what you will; and let it be his sole command. Let him be military, medical, or civilian officer, as the possession of administrative talents point out a man for the work. The departments should not be many.

(*a*) A governor, solely responsible for everything but medical treatment.

(*b*) A principal medical officer and his staff, relieved of all administration, and strictly confined to his professional duties.

(c) A steward, who shall fulfil the duties of purveyor, commissary, and barrack-master, and supply everything, subject to the governor.

(*d*) A treasurer, who should be banker and paymaster.

(*e*) A captain of hospital attendants, who should undertake the direction of the cooking, washing, care of hospital furniture, and government of orderlies.

12. All these officers must be appointed at home by the War Department. According to this plan, the governor would cumulate the functions of quartermaster-general and adjutant-general, and therefore the sanitary officer mentioned before would be attached to him instead of to he quartermaster-general.

13. The governor would be solely reponsible for carrying out the works adised, and for engaging the labor requisite o do so. In civil life all the functions ere particularized are vested in the uperintendent or house governor, subject o the final control of the board or committee of management.

14. *Supply.*—The steward should furish the hospital according to a fixed cale, previously agreed upon.

15. The mode of supply by requisitions faulty both ways, both in pretending to upply that which is not in store, and in ot supplying that which is; for the reuisition remains, although the supply as never been given; and the supply is ot often given, although it is in store.

16. With regard to food, let the steward ake contracts, subject to the governor's pproval, and with power to buy in the arket at the contractor's expense, if the ntractor fails.

17. A scheme of diets should be framed, cording to the most approved authoris, in order to save the cumbrous machiry of extra diet-rolls.

18. Equivalents should be laid down, as to afford the necessary choice, dending on the nature of the climate, the ason of the year, the state of the mar, the productions of the country, etc.

19. A registrar is an essentially necessary officer in a military general hospital. The absence of registration in the hospitals at Scutari left the accounts in general, and those of mortality in particular, of no reliance. "They convey no trustworthy idea as to the sickness and mortality of the army in the East."

20. The medical officers of our hospitals of the United Kingdom, whether physicians, surgeons, or apothecaries, are appointed by the votes of the governors, or by the nomination of council, as in the instance of the King's College and University Hospitals of London. The election to office by vote of the governors is, however, by far the more general mode.

21. *Hours of visiting.*—The hours for performing the medical and surgical services of hospitals would seem to depend on and be regulated by social habits; the visits being paid in France in the early morning, and in England during the afternoon.

22. *Number of beds to each Physician and Surgeon.*—M. de Watteville limits the number of patients to be placed in charge of each medical officer to forty; while in England the average appears to vary considerably. In our large London hospitals it is much above this number. The average of four such hospitals gives sixty-two beds to each officer having charge of in-patients; which number, however, is somewhat diminished in practice by the habit of allowing beds to obstetric physicians and assistant-surgeons. In the country the allowance is very much less. The average of eight country hospitals gave only twenty-five beds to each officer having charge of in-patients.[1]

Subdivision, distribution, and selection of the sick. — The proper subdivision and selection of the sick and wounded must everywhere constitute a primary consideration of hospital construction and general arrangement, for there is a certain ratio between the number of sick placed in a building, and in a ward, and the amount of mortality.

2. The number of patients admitted into an hospital does not by any means indicate the number of lives preserved, the degree of misery lessened, the sum of benefit to the community. The proportion actually cured and relieved, in a given brief period, is what truly expresses the happy consequences to society.

3. The system of hospitals is too often founded in error; the true system being founded on the principle of relieving and dismissing in a short time; and thus the

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[1] The numbers are taken from the Appendix to the Sixth Report of the Medical Officer of the Privy Council.

sum of patients relieved in a given period may be even greater from a less than from a larger number of inhabitants.

4. The extent to which subdivision should be carried must be determined by the twofold consideration of uniting the greatest advantages as to health, with the greatest facilities as to administration, reference being had to economy.

5. Too great a subdivision of sick must necessarily incur an increase of cost in administration and nursing. On examing the experience of British and French hospitals, it is found that from a hundred to a hundred and twenty sick may safely and economically be treated under one roof, provided the ventilation and cubic space be sufficient, and the structure and communications of the building be so arranged as to facilitate the administration and nursing.

6. The wards should hold from twenty-five to thirty-two sick; each bed having from 1500 to 2000 cubic feet of air-space allotted to it.

7. The following table exhibits the proportions of a ward for thirty-two patients; the first column gives the proportions of such a ward in the Lariboisière Hospital; the second, the proportions adapted to a larger cubical space, such as is given in our best hospitals in this country:—

Proportions of Ward.	feet.	in.	feet.	in.
Length of ward	111	6	128	0
Breadth	30	0	30	0
Height	17	0	17	6
Wall-spaces between end-walls and windows . .	5	0	6	4
Breadth of windows . .	4	8	4	8
Breadth of wall-space between windows . .	9	2	11	4
Height of windows . . .	13	0	13	6
Cubic space per bed .	1760	0	2100	0

8. The proportions of a ward for twenty patients might be 80 feet long by 25 feet wide and 16 feet high; this would give about 1600 cubic feet to each bed.

9. One window at least should be allotted to every two beds, for purposes of light and air; there are hospitals with a window to each bed.

10. Much has of late been said about the benefits of small wards for from six to ten sick, about the greater comfort and privacy of such wards, and the greater facility for ventilation which they afford. It is simply an error to assume that small wards afford any such advantages. Privacy in an hospital does not extend beyond any two adjacent beds.

11. Each bed should have a space of eight feet on the average, with twelve feet between foot and foot; beds should be at least three feet apart; and where there are bad fever-cases, one bed should be empty, for the purpose of isolating each such patient. Impure air, whether emanating from the person or the excretions, diminishes as the square of the distance.

12. In our civil hospitals in England, the amount of cubic space varies from 600 to 2000 cubic feet per bed; in Paris, 1700; and in London, 2000, and even 2500 cubic feet are now thought advisable.

13. In some military hospitals it was under 300; 700 to 800 appear to have been considered a somewhat extravagant allowance. The army regulation as to cubic space in hospitals was, up to a recent period, overcrowding.

14. In open sites and in the country a less cubic space is demanded than in towns. In detached pavilions, or in tents, especially if they be of but one story high, less cubic space is required than where numbers are massed together.

15. The very constitutions of sick and wounded persons render them more susceptible of morbid impressions than the healthy; the sick, therefore, ought always to enjoy a larger breathing-space than the healthy.

16. Cubic space above the bed is not sufficient for the sick, who should have a sufficient surface-area also between the adjoining and the opposite beds. For the comfort and welfare of the sick each bed should have a surface-area of at least 8 feet wide by 12 feet long.

17. There will be a high rate of mortality amongst healthy men in large barracks, and a low rate in separate huts, even with a much less cubic space.

18. The largest of the Scutari hospitals, which contained at one time 2500 sick and wounded under its roof, and where at one time, not half even of regulation amount of cubic space was given, lost two out of five of the patients treated; while in the hospital-tents of the Crimea, the sick being almost without shelter, without blankets, without proper food or medicines, the mortality was not above one-half what it was at Scutari.

19. But this was not the only danger of overcrowding; eighty cases of hospital gangrene were recorded during one month at Scutari, and very many more occurred which were not recorded and out of forty-four secondary amputations of the lower extremities performed consecutively, thirty-six died. Fever also broke out in this miserable hospital, not by tens but by hundreds.

20. No stronger condemnation of any hospital or ward can be pronounced than the simple fact of any zymotic diseas

originating in it, or that such diseases have attacked other patients than those brought in with them.

21. With proper sanitary precautions, diseases reputed to be the most infectious may be treated in wards among other sick without any danger.

22. As to the proper distribution of the sick, four wards of ten patients each, taking the average of patients in London, cannot be efficiently overlooked by one head-nurse. Forty patients in one ward can be fully overlooked by one head-nurse.

23. Let us accept the principle that no hospital shall exceed two floors in height. By such an arrangement and construction the sick are spread over a wider area, the walls are not so high as to interfere with the sunlight and ventilation of the neighboring pavilions, the accumulation of hospital miasm in the upper flats is avoided, access to the wards is easier for patients and attendants, and the whole administration is much facilitated.

24. "It will cost more money to accommodate a given number of sick in a hospital of two than in one of four flats; but the question has been discussed and decided on the continent, notwithstanding, that the hospital of two flats is better than one of additional stories; and many hospitals of two stories have there been built.

25. "But even admitting the argument of the expensiveness of land as being entirely valid, the conclusion is certainly not that hospitals three and four flats high should be built in towns; but that hospitals should be built in the country where land is less expensive.

26. "It is little else than a breach of trust to build great lofty architectural structures merely to flatter the bad taste of committees or governors; or to place the hospitals in a close unhealthy neighborhood, to suit the convenience of medical attendants, when the object of the whole ought to be the recovery of the sick.

27. "The number of sick which may be safely placed under one roof will, to a certain extent, be determined by the local position of the hospital, by the extent of cubic space allotted to the patients, and by the state of ventilation. In the most recent hospitals the numbers vary considerably.

28. "Thus, in the Royal Marine Hospital, which is at present being erected at Woolwich, 84 sick are to be accommodated under one roof. In the proposed hospital at Aldershott there will be arrangements for about 100. In each of the hospital blocks at Beaujon, in Paris, there are arrangements for 60 sick. In the magnificent hospital Lariboisière, at Paris, the number is 102 per block. In the hospital St. Jean, at Brussels, it is about 88.

29. "Too great a subdivision of sick must necessarily incur an increase of cost in administration and nursing. On examining the experience of all these hospitals, we are of opinion that from 100 to 120 sick may be safely and economically treated under one roof, provided the ventilation and cubic space be sufficient, and the structure and communications of the buildings be so arranged as to facilitate the administration and nursing."

30. Where labor is misapplied, it often happens that more time and care are given to passages, stairs, etc., than to the sick. To obviate this, extreme simplicity of construction and detail is essential.

31. Small casualty wards are much better placed apart, with their staff complete and separate, rather than attached—one small ward to each larger one.

32. Much superfluous argumentation has been thrown away upon the questions of the arrangement and distribution of sick in hospitals; discussions which might have been spared, had better hospitals existed in times past. Even now, indeed, much of what is set forth in this essay applies mainly to hospitals as they are; for it may be received as a truth having few exceptions, that if ventilation, cleanliness, and the general hygiene of an institution be duly attended to, we need trouble ourselves but little as to what description of cases shall be placed in adjoining beds in our wards, provided always that noisy or troublesome patients receive their special and proper places.

33. Eruptive diseases, eruptive fevers, erysipelatous diseases, ophthalmia, have been considered as demanding separate and more or less strict seclusion, on account of the safety of others; so much so indeed, that for the treatment of some of the diseases mentioned special hospitals have been founded.

34. Robert Jackson gives preference to the upper floors of hospitals which consist of two stories for the reception of cases suffering from acute diseases, as being less exposed to noise and bustle.

35. The benefits of classing the sick according to similarity of disease he considers as obvious, as regards economy of labor, facility for prescribing, and correct appreciation of effect.

36. An active discussion has lately taken place in the professional, and also in the public, journals, on the advantages and disadvantages of special hospitals for the separate treatment of various diseases. The question is an important one; and it is probable that it will receive a final settlement in financial considerations, and those connected with the public and the professional convenience.

37. When we contrast the incomes and the amount of actual relief, for instance, of the fourteen metropolitan general hospitals, with the incomes and the amount of relief in the thirty-six special hospitals of London, we arrive at once at a conclusion in favor of the former institutions, on the score of financial and charitable advantages.

38. What appears to be wanted is, to bring the two classes of institutions together under one roof; the general hospitals classifying special diseases in special wards, as is already done in some of our great hospitals. By such arrangement the general hospitals will increase in power and usefulness, and the special hospitals will gradually give place to the cheaper and more beneficial charity.

Admission into Hospital.—The justice of the principle is unquestionable, that all indigent sick inhabitants, and all poor wayfarers who may fall sick on their travels, ought to be admitted into the nearest hospital; indeed, no hospital establishment, whether in our great cities or in the provinces, can be said to be complete until this desideratum shall be accomplished. All servants of the public, all seamen and soldiers of the state, should have free admission into the nearest civil hospital, it being understood that naval and military hospitals are too distant to be resorted to.

2. It has often been said that the greatest cause of inefficiency in all our general hospitals, whether in town or country, is the mode of admission of patients by governors' letters. This cause of inefficiency, according to Dr. Fenwick, who is here followed, exists in every hospital in England, with exception to the old endowed hospitals of London, the Royal Free, and the Metropolitan Free hospitals.

3. It is an evil which has towering proportions among the grievances of our calling; an evil which could only have arisen at an epoch when charity was misunderstood, and when medical men were content to do with humility the bidding of rich people, even if the result should be dishonoring to the best traditions of medicine.

4. The system of admission by letters of governors entails such evils as the following.

(*a*) The admission of trivial cases.

(*b*) The admission of cases incurable, either from their stage or their nature.

(*c*) The crowding of the wards in undue proportion with patients suffering from chronic maladies.

(*d*) The detention of patients for fixed periods, with little regard either to the medical aspect of the cases, or the general necessities of the hospital; the impossibility of preventing over-crowding in times of epidemic pressure; the utmost perplexity to the direction when it becomes necessary suddenly to empty some, or the whole of the wards, for health-purposes; but above all, the necessary exclusion of cases for which hospitals were originally designed, and the existence of which alone justifies their maintenance.

5. Nothing is here said of the financial embarrassments which constantly hover over institutions that endeavor to do their duty to the public by admitting urgent cases and accidents, while they try to perform their contract with the subscribers by taking in persons sent under the authority of their recommendatory letters.

6. Nothing is said, again, of the wholesale admission of improper persons, without inquiry as to their being fit recipients of any form of charity. What is now desirable is, that these letters—or rather orders, as they are generally interpreted—shall no longer be permitted to throw an air of a sham over our British Hospital System. It is almost unnecessary to state that these ignoble letters do not exist in any part of the continent, have no place at St. Bartholomew's, Guy's, or St. Thomas's, and are quite unknown in the Royal Infirmary of Edinburgh.

7. The only objection worthy of consideration to the overthrow of this privileged system is, the often-urged declaration, that subscriptions could not be obtained unless the privilege of recommending patients were appended to them.

8. This is believed to be a delusion. Is it probable that the sort of people who maintain the charities of England contribute their money for the purpose of obtaining a "privilege"? Was this the motive which prompted the gifts to the Coventry weavers, to the poor Indian rice-growers, or to the Lancashire spinners? If it be made but generally understood by the public that the governing bodies and the medical officers of hospitals will always prove the best judges of the class of persons proper to be admitted to the benefits of each kind of charity, rights and privileges on the part of donors and subscribers will speedily be abandoned.

9. It is believed that many of the hospitals in London envy the subscription-list and the donations of the Royal Free Hospital, although it does not enjoy the *prestige* of a school, or of an hospital staff.

10. Some of the largest subscription-lists in England look insignificant by the side of that of the Edinburgh Royal Infirmary, though the city is not rich; yet on the fly-leaf of its reports we read this noble sentence—"that the selection of patients to be admitted shall be regulated solely by a regard to the relative urgency and severity of their ailments."

11. In the city here named, there is a Children's Hospital, now in its seventh year of progress. The governors have no privilege whatever, not even that of electing medical officers. The annual subscription-list has already amounted to nearly £1100. There is, then, no reason for the averment that the public is not ready to support hospitals for their own sake, as necessary public charities. The time has come, as it appears to the author, for taking the verdict of our brethren on this important question.

The selection of patients.—Dr. Guy regards it as a fact that the great leading cause which determines the mortality of hospitals is the question here noticed. He says that "the attendance of a numerous class of pupils craving for instruction leads naturally and necessarily to a selection of severe and dangerous cases, while the attachment of practitioners to their *alma mater* brings about with equal certainty a supply of cases for medical treatment and for surgical operation, among which cases an undue mortality may be expected to occur.

2. "That this is the true explanation of the higher rates of mortality to be found in the tables published by the Statistical Society of London, is rendered in the highest degree probable by the fact that the four hospitals which present the highest rates of mortality are St. Bartholomew's and Guy's, King's College and University College. In the last of the series of published tables, the mortality of these four hospital-schools is shown to range from 110 to 115 in 1000. The other hospital-schools are found to occupy an intermediate position between the four hospitals which have the honorable distinction of a higher rate of mortality and the hospitals which have no medical schools attached, and which enjoy the unenviable privilege of displaying a rate of mortality rising from 60 to 82 in 1000.

3. "Seeing that the rate of mortality in hospitals varies so little with locality, site, size, spaciousness, and so much with the sex of patients, and the medical and surgical character of their maladies, it is obvious that more may be done to raise or lower the rate of mortality of our hospitals by selection of patients than by all other causes put together, excepting always such a degree of overcrowding and neglect of obvious sanitary precautions as are no longer possible in the hospitals of London.

4. "It must also be quite evident that if, to an unequal distribution of men and women, and a variable proportion of medical and surgical cases, we were to add the element of a selection by one hospital of the more serious class of cases, surgical and medical, and by another of cases of a less severe character, we should be able to produce at will almost any rate of mortality between the limits of 50 or 60 per 1000 and 110 or 120 per 1000.

5. "Now, this sort of selection does go on almost unconsciously in the case of those hospitals which have attached to them medical schools, and in the greatest degree in those which have the largest schools, and through them the largest connection of old students."

Such are the conclusions of Dr. Guy upon this most important question; and he promises to follow them up by a careful statistical record. We look forward with interest to the fulfilment of that promise; for the value of all opinion must end where demonstration begins.

THE DIETING OF THE SICK—HOSPITAL COOKING.

Regarding the practical common-sense views of Miss Nightingale to be of that kind of pure observation which so frequently precedes science, and which is always so profitable to undemonstrated science, I propose here to quote her rules on the subject of dieting the sick to some extent. I should desire, indeed, to quote her two articles entire, but space will not admit of such indulgence.

It is confidently stated that the diet in London generally, as compared to that of Paris, is more substantial, nourishing, and invigorating; and this advantage is said to attach to the Englishman both before and after he becomes a patient in the hospital.

2. "In laying down rules of diet by the amounts of 'solid nutriment' in different kinds of food, it is constantly lost sight of what the patient requires to repair his waste, what he can take and what he cannot.

3. "You cannot diet a patient from a book; you cannot make up the human body as you would make up a prescription—so many parts 'carboniferous,' so many parts 'nitrogenous,' will constitute a perfect diet for a patient. The nurse's observation will here materially assist the doctor; the patient's 'fancies' will materially assist the nurse.

4. "Organic chemistry is useful, as all knowledge is, when we come face to face with nature; but it by no means follows that we should learn in the laboratory any one of the reparative processes going on in disease.

5. "Chemistry has as yet afforded little insight into the dieting of sick. All that chemistry can tell us is the amount of 'carboniferous' or 'nitrogenous' elements discoverable in different dietetic articles. It has given us lists of dietetic substances,

arranged in the order of their richness in one or other of these principles; but that is all.

6. "In the great majority of cases, the stomach of the patient is guided by other principles of selection than merely the amount of carbon or nitrogen in the diet. No doubt, in this as in other things, Nature has very definite rules for her guidance; but these rules can only be ascertained by the most careful observation at the bedside. She there teaches us that living chemistry, the chemistry of reparation, is something different from the chemistry of the laboratory.

7. "An almost universal error amongst nurses is the bulk of the food, and especially of the drinks they offer to their patients. Suppose a patient ordered four ounces of brandy during the day; how is he to take this if you make it into four pints by diluting it? The same with tea and beef-tea, with arrowroot, milk, etc. You have not increased the nourishment, you have not increased the renovating power of these articles by increasing their bulk; you have very likely diminished both by giving the patient's digestion more to do; and most likely of all, the patient will leave half of what he has been ordered to take, because he cannot swallow the bulk with which you have been pleased to invest it.

8. "It requires very nice observation and care (and meets with hardly any) to determine what will not be too thick or strong for the patient to take, while giving him no more than the bulk which he is able to swallow. . . . . . The diet which will keep the healthy man healthy will kill the sick one. The same beef, which is the most nutritive of all meat, and which nourishes the healthy man, is the least nourishing of all food for the sick man, whose half-dead stomach can *assimilate* no part of it, that is, make no food out of it."

9. Respecting beef-tea and other articles of diet, much error has been heedlessly accepted for truth: "One is the belief that beef-tea is the most nutritious of all articles." It is of little dependence "with the healthy and convalescent, where there is much nourishment required. . . . . . . On a diet of beef-tea healthy men speedily lose their strength."

10. But "there is a certain reparative quality in it—we know not what;" and "it may safely be given in any inflammatory disease."

11. Dr. Christison observes, that "every one will be struck with the readiness with which certain classes of patients, as cases of gastric fever especially, while they refuse all other food, take readily to beef-tea or dilute meat-juice, using little or nothing else for weeks or even months; and yet a pint of beef-tea contains scarcely ¼ oz. of anything but water." The result, however, is so striking that he asks what is the mode of action. "Not simply nutrient, ¼ oz. of the most nutritive material cannot nearly replace the daily wear and tear of the tissues in any circumstances. Possibly," he says, "it belongs to a new denomination of remedies."

12. "It has been observed that a small quantity of beef-tea, added to other articles of nutrition, augments their power out of all proportion to the additional amount of solid matter. The reason why jelly should be innutritious, and beef-tea nutritious, to the sick, is a secret yet undiscovered; but it clearly shows that careful observation of the sick is the only clue to the best dieting.

13. "It is an ever-ready saw that an egg is equivalent to a pound of meat; whereas it is not at all so. Also, it is seldom noticed with how many patients, particularly with nervous and bilious temperaments, eggs disagree. All puddings made with eggs are distasteful to them in consequence. An egg whipped-up with wine is often the only form in which they can take this kind of nourishment.

14. "Again, if a patient has attained to eating meat, it is supposed that to give him meat is the only thing necessary for his recovery; whereas scorbutic sores have been actually known to appear among sick persons living in the midst of plenty in England, which could be traced to no other source than this, viz., that the nurse, depending on meat alone, had allowed the patient to be without vegetables for a considerable time, these latter being so badly cooked that he always left them untouched.

15. "Arrowroot is another grand dependence of the nurse. As a vehicle for wine, and as a restorative quickly prepared, it is all very well. But it is nothing but starch and water. Flour is both more nutritive, and less liable to ferment, and is preferable wherever it can be used.

16. "Flour, oats, groats, barley and their kind are preferable in all their preparations to all the preparations of arrowroot, sago, tapioca, and their kind.

17. "Milk and all the preparations from milk, are a most important article of food for the sick. Cream, in many long chronic diseases, is quite irreplaceable by any other article whatever. It seems to act in the same manner as beef-tea, and to most it is much easier of digestion than milk. In fact, it seldom disagrees.

18. "Butter is the lightest kind of animal fat; and though it wants the sugar and some other elements which there are in milk, yet it is most valuable both in

itself and in enabling the patient to eat more bread.

19. "Cheese is not usually digestible by the sick, but is pure nourishment for repairing waste; and I have seen sick, and not a few either, whose craving for cheese showed how much it was needed by them."

20. In a note on the instinctive cravings of the sick, Miss Nightingale makes an observation, the truth of which will be vouched for by all who, like her, have seen scorbutic dysentery: "In diseases produced by bad food, such as scorbutic dysentery and diarrhœa, the patient's stomach often craves for and digests things, some of which certainly would be laid down in no dietary that ever was invented for sick, and especially not for such sick. These are fruit, pickles, jams, gingerbread, fat of ham or bacon, suet, cheese, butter, milk. These cases I have seen, not by ones, nor by tens, but by hundreds. And the patient's stomach was right, and the book was wrong. The articles craved for, in these cases, might have been principally arranged under the two heads of fat and vegetable acids.

21. "There is often a marked difference between men and women in this matter of sick feeding. Women's digestion is generally slower."

22. Reverting to the article of milk, Miss Nightingale says: "But, if fresh milk is so valuable a food for the sick, the least change or sourness in it makes it perhaps of all articles the most injurious, diarrhœa being a common result of fresh milk allowed to become at all sour. The nurse therefore ought to exercise her utmost care in this.

23. "Buttermilk, a totally different thing, is very useful, especially in fevers.

24. "The nutritive power of milk and of the preparations from milk is very much undervalued; there is nearly as much nourishment in half a pint of milk as there is in a quarter of a pound of meat. But this is not the whole question, or nearly the whole. The main question is, what the patient's stomach can assimilate or derive nourishment from; and of this the patient's stomach is the sole judge. Chemistry cannot tell this. The patient's stomach must be its own chemist.

25. "I have known patients to live for many months without touching bread, because they could not eat bakers' bread. These were mostly country patients, but not all. Home bread or brown bread is a most important article of diet for many patients. The use of aperients may be entirely superseded by it. Oat cake is another."

26. Miss Nightingale justly observes that sound observation has scarcely yet been brought to bear on sick diet. "To watch for the opinions which the patient's stomach gives, rather than to read 'analyses of foods,' is the business of all those who have to settle what the patient is to eat; perhaps the most important thing to be provided for him after the air he is to breathe."

27. The circumstances which call for variations as to quality and quantity of food in hospitals are: Nature of the disease, whether acute or chronic, sthenic or asthenic; age; sex; previous habits of life; employments; season; conformation of body.

(*a*) *Nature of the disease.*—There is perhaps no diseased state found in hospitals for the cure of disease, in which so much food should be given as in health. In acute disease, the activity of all the functions must be lessened, and therefore less food of all kinds given, especially of the nitrogenous kind, since on that quality mainly depends the activity of function. In chronic disease there is usually a reduced state of the powers of transformation, and hence starchy food should not be given in excess, while a full admixture of nitrogenous food is called for. Moreover, the heart's action is often enfeebled in such states, and then nutritive articles of diet, with ale or wine, are called for.

(*b*) *Age.*—Under the age of twenty-two, some excess of food must be allowed to maintain growth. In old age the quantity should be less than in middle life, and then the quality should be such as to contain more nitrogenous food, or that which promotes the transformation of starch and fat. Arrowroot taken alone is then wasted, and probably the same may be said of fat.

(*c*) *Sex.*—The difference in the amount of nutriment required by the two sexes is less than is found in the dietaries of gaols. The chief ground for the difference is, the difference in weight and size of the body.

(*d*) *Previous habits and employments.*—These considerations must constitute a reason for variation in diet; but, from evident causes, the requirements can only be met by having two or more classes of dietaries, one of which shall suffice for those whose occupations have been more laborious, and another for such as have been of sedentary habit, more nutriment being, as matter of course, required for the former class.

(*e*) *Season.*—The quantity of food supplied in the winter months should be one-sixth greater than in June, July, August, and September, and it should be rich both in nitrogen and carbon. In the summer months the quantity of starch and fat should be much lessened, and in a greater degree than the nitrogenous, since then the powerful indirect transforming action of cold is absent.

(*f*) *Conformation of body.*—The chief circumstance here to be noticed is, that persons of unusual height and girth demand an unusual supply of food.

28. Dr. Edward Smith offers the following suggestions for a scheme of dieting fitted for the Liverpool Infirmary and the general hospitals of the country :—

"There should be but three dietaries.

(*a*) "The normal one, which would be proper for ordinary cases, where the supply should as nearly as possible balance the waste.

(*b*) "The sick dietary, suited to acute cases, in which the supply is insufficient to balance the waste.

(*c*) "The convalescent dietary, in which the supply is greater than the waste. Such terms as 'low,' 'full,' etc., are inadmissible, since they influence the minds of the patients, and probably mere numerical distinctions would be best.

29. "There should not be such variation in the food supplied from day to day as would materially vary the amount of nutriment supplied; and when alterations are provided, they should be nearly equal in nutritive value; as, for example, eggs for milk, or peas for cereals. Such alteration should be exceptional, and be applied to the special case of the patient.

30. "Milk should form a large part of every hospital dietary. Thus, in B three-fourths of a pint at breakfast and supper; and in C a pint at each of those meals.

31. "I doubt much if more than four oz. of cooked meat without bone ought to be given to men, or more than three oz. to women in any class, and I should recommend these quantities in B and C. I am persuaded that too much meat is given in many hospital and prison dietaries, considering the healthfulness, vigor, and duration of life of the agricultural population living almost without it, and also the evils met with in towns' populations, amongst the well-fed, who yet seldom eat more than the above allowance. I have seen great evils in hospital practice from an unlimited supply of meat, even in such cases as phthisis."

SCHEME.

	A (sick).	B (normal).	C (convalescent).	NOTES.
BREAKFAST, 8½ A. M.	⅓-pint milk, 3 oz. bread (or oatmeal).	¾-pint new milk, 6 oz. bread, 2 oz. oatmeal.	1 pint new milk, 8 oz. bread, 3 oz. oatmeal.	N.B. The milk should be new or old, as fat is improper, or otherwise.
		When cocoa or coffee with sugar is given, omit the oatmeal, and give ½-pint milk.		
DINNER, 1½ P. M.	⅛-pint milk, made into pudding, with rice, sago, etc.; or ½-pint beef-tea, 4 oz. bread.	Meat, 4 oz. men, 3 oz. women, Bread, 6 oz. Potato, 8 oz. Cheese, ½ oz.	———— 4 oz. ———— 3 oz. ———— 8 oz. ———— 8 oz. ———— 1 oz.	The *beef-tea* should be made hot or cold, as the albumen is improper, or otherwise.
		¾-pint of broth, with boiled meat.		In A and C the broth should contain herbs.
SUPPER, 6½ to 7; bed at 8.	All the same as breakfast, with addition of cereal.			In all, salt supplied *ad. lib.* Malt liquors as exceptions.

32. "The meat should be of the best quality, from good joints, be served hot, be roasted or boiled, and be varied in kind; and when boiled, the liquor should be served with it.

33. "Considering that potato is two-and-a-half times dearer than an equal amount of nutriment in bread, I would limit the supply of it to half-a-pound, cooked.

34. "Seeing that in a day of fasting the carbon exhaled is equal to that contained in twenty ounces of bread, the daily supply of bread to B should not be less than eighteen ounces, and to C not less than twenty-four ounces.

35. "Cheese, in small quantities, should be supplied after dinner, both because it promotes the transformation of food, and adds largely to the nitrogen. Half-an-ounce to B, and one ounce to C. When bread and cheese is preferred to bread and milk for supper, it would be easy to

determine the suitable equivalent, since cheese also contains fat.

36. "I cannot think that tea is proper in B and C, except when the assimilative function is much deficient, and then the bulk of fluid should be so small as to admit of the addition of half-a-pint of milk. I would make it an exceptional article of dietary.

37. "Coffee might with less impropriety be given with half-a-pint of milk for breakfast; but it is clear that both tea and coffee tend to increase waste.

38. "The various cereals with milk are the most suitable for breakfast and supper.

39. "In my opinion, a sick dietary should differ from the foregoing only in the lesser quantity of the above-mentioned articles, and care should be taken not to rely upon such articles as tea, which increases waste, or beef-tea made hot, which can only very partially sustain the animal functions. I think a too great deficiency of nutriment is often found in the 'low diet.'

40. "In the above scheme there should be fat in the milk (¾ oz. in 1 pint) and in the well-fed flesh (⅛), and this, with or without butter, would be ample, in addition to the starch supplied in the cereals and the potato. I have also been influenced in my opinions by my experiments published in the Philosophical Transactions for 1859, and in the Dublin Quarterly Journal for February, 1860."

41. *Cooking.*—"Many a patient can eat," says Miss Nightingale, "if you can only tempt his appetite; the fault lies in your not having got him the thing that he fancies.

42. "But another patient does not care between grapes and turnips—everything is equally distasteful to him. He would try to eat anything which would do him good; but everything 'makes him worse.' The fault here generally lies in the cooking.

43. "It is not his 'appetite which requires tempting'—it is his digestion which requires sparing. A good sick-cook will save the digestion half its work.

44. "There may be four causes, any one of which will produce the same result, viz., the patient slowly starving to death from want of nutrition:—

i. Defect of cooking.
ii. Defect in choice of diet.
iii. Defect in choice of hours for taking diet.
iv. Defect of appetite in the patient.

Yet all these are generally comprehended n one sweeping assertion, that the patient as 'no appetite.'

45. "Surely many lives might be saved y drawing a closer distinction; for the emedies are as diverse as the causes. The remedy for the first is to cook better; for the second, to choose other articles of diet; for the third, to watch for the hours when the patient is in want of food; for the fourth, to show him what he likes, and sometimes unexpectedly. But no one of those remedies will do for any other of the defects not corresponding with it.

46. "I cannot too often repeat, that patients are generally either too languid to observe these things, or too shy to speak about them; nor is it well that they should be made to observe them; it fixes their attention upon themselves.

47. "Again I say what *is* the nurse or friend for, except to take note of these things, instead of the patient doing so?

48. "It is commonly supposed that the nurse is there to spare the patient from making physical exertion for himself; I would rather say, she ought to be there to spare him from taking thought for himself. I am quite sure that if the patient were spared all thought for himself, and *not* spared all physical exertion, he would be infinitely the gainer.

49. "The reverse is generally the case in the private house. In the hospital, it is the relief from all anxiety, afforded by the rules of a well-regulated institution, which has often such a beneficial effect upon the patient."

NURSING AND NURSES.

In military hospitals.—In all European states there are more women than men above twenty years of age; and we may assume that such is the law of nature, and that it is designed to answer beneficent ends in human society.

It should seem obvious enough that the virtues which in all ages and all countries have ruled the domestic circle; that "she who looketh well to the household, and eateth not the bread of idleness;" that she whose "tongue is the law of kindness," should have a natural and a large share in the tending of the sick and maimed. To the natural care of the sick and wounded, we must add the natural care of the infant and the aged, along with the household cares and the rearing and training of children.

Requirements of so extended and important a character, capable of such infinite development, cannot be limited to the household affairs of common life. They must be brought systematically in aid of the sick in hospital, for purposes of nursing and of general administration.

2. One of these ends, whether in private or public relation, would appear to be the care of the sick; an occupation for which woman, whether taken from the in-

stinctive tuitions of the sanctuary of home, or from the trained service of the hospital, possesses unequalled aptitude and capabilities. Everywhere and at all times the number of nurses to be employed in a hospital must be regulated by the nature of the prevailing diseases, whether epidemic, acute, or chronic.

3. So far back as 1791, we find it stated by the governors of the London Hospital, that "women are better judges than men upon many occasions; particularly in what relates to women's wards, the laundry, the kitchen, to beds, linen, etc."

4. Donald Monro, in his observations on "Movable Hospitals on Expedition Service," speaks of the "matron or head-nurse," and of the "common nurses," as ordinary matter-of-course parts of the hospital service of his time (1760-1780), and he proposes excellent regulations for their conduct.

5. In the Artillery Hospital, Woolwich, in 1801, Dr. Rollo states that a matron and nurse formed part of the permanent establishment. "There was a nurse to every three wards, being a charge of fifteen or sixteen patients, whose duty it was to attend upon the men, make their beds, supply them with drinks, keep them clean, and take the charge of preserving the furniture and utensils, and of washing and sweeping the rooms. The duty of washing and sweeping the galleries and passages is done by the nurses alternately in a period of a week at a time. They also take in rotation the duties of night-nurses, when there are patients requiring such attendance."

6. In the artillery hospitals in the West Indies, a nurse was allowed for every twelve sick. Dr. Rollo adds, that "the nurses and servants ought to be entirely under direction of the surgeon, and to be answerable to him alone for their conduct, and for holding their appointments."

7. As regards the principle of female service, our main object should be, to improve hospitals by improving hospital-service; and to assure so essential a benefit to the sick, we must improve the class of nurses and head-nurses.

8. Miss Nightingale thinks that the woman is superior in skill to the man in all matters of sanitary domestic economy, and more particularly in cleanliness and tidiness. Sanitary civil reformers will always tell us that they look to the women to carry out practically their hygienic reforms. She has a superior aptitude in *nursing* the well quite as much as in nursing the sick. At the same time, Miss Nightingale is bound to say that nothing can be more perfect, at least to outward appearance, than the cleanliness of a ship. But the sailor is a race *à part*.

9. It is the peculiar skill and industry of the English laborer's wife to which all this is referable in the one case, and to the incompetency of men on the other to conduct the domestic economy of a home or a hospital. Miss Nightingale thinks the Anglo-Saxon would be very sorry to turn women out of his own house, or out of civil hospitals, hotels, institutions of all kinds, and substitute men-housekeepers and men-matrons. The contrast between even naval hospitals, where there are female nurses, and military hospitals, where there are none, is most striking in point of order and cleanliness.

10. There is a great difference in Miss Nightingale's experience, generally speaking, among the women of Great Britain and Ireland in this respect. She would put the Anglo-Saxon race in the southern and northwestern counties first in point of domestic management; far below these come the Danish race in the eastern counties, and the mixed race in the manufacturing counties; and last, the Irish and Highland and Celt.

11. Our authority proposes to introduce so great and necessary an improvement into our hospital management, "not by founding a religious order, as on the continent of Europe, but by training, systematizing, and morally improving, as far as may be permitted, that section of the large class of women supporting themselves by labor, who take to hospital nursing for a livelihood; by inducing, in the long-run, some such women to contemplate usefulness, and the service of God in the relief of man, as well as maintenance; and by incorporating with both those classes a certain proportion of gentlewomen who may think fit to adopt this occupation without pay, but under the same rules, and on the same strict footing of duty performed under definite superiors. These two latter elements, if efficient (if not, they would be mischievous rather than useless), I consider, would elevate and leaven the mass.

12. "The care of the sick is the main object of hospitals. The care of their souls is the great province of the clergy of hospitals. The care of their bodies is the duty of the nurses. Possibly this duty might be better fulfilled by religious nurses than by sisters of any order: because the careful, skilful, and frequent performance of certain coarse, servile, personal offices is of momentous consequence in many forms of severe illness and severe injury; and prudery, a thing which appears incidental, though not necessarily so, to female orders, is adverse to or incompatible with this.

13. "Grave and peculiar difficulties attend the incorporation of members of orders, especially of Roman Catholic orders, into the work. And both with

reference to the Queen's hospitals, and still more to civil hospitals, I humbly submit that much thought, and some consultation with a few impartial and judicious men, should precede the experiment of their introduction. This appears to me one of the most important questions for decision. Should it be decided in favor of their introduction, I trust it may be resolved to do so only tentatively and experimentally.

14. "Their introduction is certain to effect far more harm in some ways than it can ever effect good in others." Their incorporation, especially as regards the Roman Catholic Sisters, will be a constant source of confusion, of weakness, of disunion, and of mischief.

15. Nurses cannot be advantageously introduced into our regimental hospitals; but into military general hospitals female nursing might be introduced both at home and in the field, if only women of efficiency, responsibility, and of as good character as head-nurses in civil hospitals, be appointed.

16. One nurse may be allotted to not less than twenty-five bad cases; the orderlies doing, under the head female nurse, the duty done in civil hospitals by assistant nurses.

17. But the head female nurse must be in charge of all that pertains to the bedside of the patient—of his cleanliness, that of his bed and utensils, of the administration of medicine, of food, of the minor dressings not performed by the surgeon; in short, all that concerns the personal obedience of the patient to the orders of the surgeon.

18. The head female nurse must accompany the surgeon in his visits, and receive his orders. She must also be in charge of the ventilation and warming of the ward. She must report any disobedience of orderlies, as far as regards the patient's personal treatment.

19. There need be no clashing with ward-master or hospital-sergeant; on the contrary, it would be the duty of these to enforce the nurse's authority. They will have enough to do besides, with returns and accounts, and with enforcing discipline as to hours, meals, clothing, etc., among the orderlies, out of the ward.

20. The female nurses should, of course, be under a female head, whose duties must be carefully arranged, so as to be in accordance with the code of hospital regulations.

21. By hospital discipline Miss Nightingale means the "enforcing hospital treatment; and hospital treatment consists in the administration of medicine, of diet, the application of the minor dressngs, the cleanliness of the ward, that of the patient, his bedding, and his utensils; his personal obedience to the surgeon's orders as to keeping his ward, his bed, or his position, etc. etc. To enforce in all these matters obedience to the surgeon's orders, is to enforce hospital discipline.

22. "Another branch of discipline consists, no doubt, in the man's respectful demeanor to his officers, in the accuracy of the diet-rolls, returns, accounts, etc. etc. This is not here spoken of, because it is not strictly hospital work. In hospital work, the meaning of the words to be 'in charge' is, we presume, to receive the medical officer's orders, to see them obeyed, and to take measures so that they cannot be disobeyed without its being known and remedied."

23. Now, in military hospitals there is no one *thus* "in charge."

24. The ward-master or hospital-sergeant has duties so multifarious that three men could not perform them with any satisfaction; and the nursing work is generally sacrificed to the writing work, unless the ward-master be, as sometimes, though rarely, happens, a very good nurse.

25. "The orderlies do not bring 'skilled labor' to the work, and the medical-staff corps bring far less. There is no training; it is a truism, that less work is done less well in the same time by unskilled than by skilled labor.

26. "The cleaning and airing of the wards in the morning would make a housemaid laugh; at Scutari each orderly worked at it in his own way, and then the patients undid it all, and it had all to be done over again.

27. "Except when medicines were given by the medical officers themselves, or by the women, they were taken by the patient or not, at his own discretion.

28. "The meals were at first irregular, and throughout the patients scrambled for them. It occurred frequently that the bad cases, when unable to feed themselves, were not fed at all, except by the women; that a great mess of cold arrowroot and wine stood by the bedside the whole day, till it was thrown away; that the poultices were put on cold, or left on till they were hard, and then not washed off; that the bed-sores were unattended to till they had become so bad that the medical officer's attention was called to them; that the patients were left dirty, unless they asked to be washed; that utensils were never emptied more than once a-day; that the keeping certain very bad cases constantly dry and clean was almost wholly unattended to; that the patients ordered to remain in bed were as often out of bed, or even out of the ward, or smoking in the privies, when these were cleansed and ventilated. The position of surgical cases in bed was generally not attended to.

29. "Many orderly medical officers were so zealous in their duties that they would drudge through all these details, and see them carried out themselves; but this is not discipline, nor can it be, unless the medical officer were in his ward through the whole twenty-four hours.

30. "The medical staff-corps are, for the most part, nothing but sweeps and ration-carriers. There are some first-rate subjects among them; but the endowments of most of them were first-rate ignorance of the very details of nursing.

31. "If all the nurses were turned out of civil hospitals, and men engaged promiscuously, without character, to do the work, we should see the same results.

32. "The medical inspectors, as far as I saw them, with some very brilliant exceptions, regarded only hospital order and mere conduct, with little reference to the state of the patients. One patient suffering from frost-bite, who subsequently died, had not been moved for a week. Being unable to leave his bed, and having been neglected, he was found in a state indescribably horrible."

33. Every ward, or set of wards, should be under a head-nurse. Discipline is always defective under other arrangement, whether in a military or a civil hospital.

34. Of acute cases, one nurse may well take charge of forty patients; while of convalescents or persons under chronic ailments, a hundred would be sufficiently served by one nurse.

35. A single attendant can easily perform the duty of night-watching for many bad cases if the beds are so placed as to be seen from a single point. The head-nurse's room should have a window looking into her ward.

36. It is highly important that patients, who must necessarily be in various stages of sickness or convalescence, should feel that they are continually under the eye of the head-nurse.

37. It is, of course, most economical to have one ward for each head-nurse. The ward, therefore, should be large enough to occupy her whole attention; but not so large as to render its ventilation difficult.

38. Small wards cannot be overlooked with sufficient strictness, unless indeed a head-nurse is to be set apart for each—an arrangement which would enormously increase the expenses of nursing, without benefiting the patients.

Nurses in civil hospitals.—"The isolation of each head-nurse and her nurses appears to me very important. The head-nurse should be within reach and view of her ward both day and night. Associating nurses in large dormitories tends to corrupt the good, and make the bad worse. The ward should have but one entrance; and the head-nurse's room should be close to it, so that neither nurse nor
leave, nor any one enter the w
her knowledge.

2. "The day-nurses should
hours' sleep, and if it be pc
hours daily for exercise, priv
tion, or recreation. They ma
room.

3. "The night-nurses sh
duty twelve hours, with insta
if found asleep; eight hours
allowed for sleep, and four ho
exercise, private occupation, o
If they have no time to the
their mending, making, etc., t
night, sometimes innocently,
to the injury of the patients.

4. "I would not, however,
cupation at night; and doin
is far better and more awal
doing nothing. This is one of
the head-nurse should consta
I do not fancy, but at pres
positive about, cleansing or s
night. The night-nurse sho
reversible lamp, or something
out disturbing the patient
light, brighter than the dim
light properly maintained in t
night. She should have a roo

5. "At present I incline t
of the following scale. Two
are best, but it might be one
with forty beds, served by on
and three nurses.

6. "The head-nurse to sup
things, and to do the dressi
by the surgeons and dress
mainly by one nurse, whom
structs in nursing.

7. "Another nurse to do t
and mainly the cleaning; an
are over to mind the ward du
maining hours in turn, or in
with the first nurse.

8. "The third to be the
In the morning, before dres
and before the night-nurse g
all three nurses to clean the
the beds, wash the helpless

9. "Hours of administrat
cine to be fixed, and the medi
except at night, to be given
nurse.

10. "Hours of morning
poulticing and dressing to be

11. "Hours of exercise of
and nurses to be fixed and a
reference to duties. A fixe
holiday given in turn to t
good; and an annual longer
them and for the head-nurse
fortnight being a good limit.

12. "The holidays should b
in rotation during a fixed ti
and comprehended in two or t
or four at the outside; and n

clining her holiday at the proper time should be allowed it at any other.

13. "The holidays cause inconvenience no doubt, but do, on the whole, far more good than harm.

14. "No head-nurse or nurse should be out of the hospital before or after the limit of her daily exercise time, two hours, without written permission of the matron. The matron should put the cause and amount of the extension in writing, and report the same to the treasurer or chief officer at the next general meeting of the officers of the hospital. She will find this a great protection against petitions; and there is no doubt that the fewer extraordinary absences the better.

15. "Were it possible to have a small garden; in this, at strictly separated hours, the men-patients, the women-patients, the head-nurses, and nurses, the men-servants if they chose, which is perhaps not likely, could walk or sit down. In college, much effect, and much refreshment is produced by a green sward, a few trees, some shrubs, a fountain, and some seats.

16. "This arrangement would little interfere with its enjoyment by the dignitaries and their children, who require it quite as much, and it would be found in its results practically, and not poetically, useful.

17. "Hospitals are, and perhaps must be, in or near crowded thoroughfares. Streets are miserable places to walk in during a great part of the year. Nurses want and unconsciously crave for fresh air, and often half-an-hour is better than more given them close to their work; and away from the streets it would be a great preservation.

18. "I should, however, be very cautious as to introducing music or anything of that sort. Hospitals are not tea-gardens, nor homes, nor meant to be either. Great quiet, and some severity of discipline, are necessary, and ought to be exacted.

19. "I think the head-nurses should wear a regulation dress, and the nurses another: if we adopt the honest word 'livery,' in use in the hospitals, it will perhaps do no harm. Caps, dresses, and aprons should be prescribed; whether or not out-of-doors dress should be prescribed, is to be considered apart.

20. "Head-nurses and nurses might wear the same dress, and some difference n the cap would be quite distinction nough. Each should have three dresses, nd better, I think, avoid washing-stuffs. They require endless change to look deent.

21. "All nurses should rank and be aid alike, with progressive increase of wages after each ten years' good service, or a slow annual rise, which is better.

22. "Nurses should be of unblemished character; of strong active habits; of not less than thirty, nor more than sixty years of age.

23. "I incline towards giving the head-nurses 50*l.* a-year, one or two rooms (one room with an alcove and curtain would be best), fuel, and light. As to the nurses' lodging: the night-nurse should have a room to herself, the others may lodge together; entire board, fuel, light, and good wages to be given.

24. "The nurses' room should be supplied with plain comfortable furniture. In large hospitals, the head-nurse furnishes her own room or rooms, which doubtless promotes her comfort and her care of the furniture — both desirable things; yet the tendency of many to accumulate decorations, which take time to clean, etc., is a drawback.

25. "I should be inclined, as an experiment, to try the furnishing plan, or at least, to have some scale as to furniture allowed. A bed, arm-chair, and sofa; a chest of drawers, wash-hand table or shelf; bookcase or shelves, a little table and a large one, a couple of chairs, a footstool, and a cupboard with broad shelves, are the utmost that can be required.

26. "All provisions, etc. etc., should be as much as possible brought into the wards, or to the ward-doors, by lifts. Nothing should be fetched by the nurses. This would save much time, would enable the nurses to do more work, and yet have more leisure; and above all, would obviate the great demoralization consequent on the nurses, patients, and men-servants congregating in numbers several times daily.

27. "The patients should be made as useful as possible, consistently with their capacities, inside the ward; but should be permitted to fetch nothing into it.

28. "A difficult and important point to settle is the amount of liberty allowed as to receiving visits. It is desirable on all accounts to make head-nurses and nurses feel comfortable, and, as it were, at home; it is also better they should not be unnecessarily out; also London distances are great, and even omnibus fare is a consideration; also it is important to remember that these women are apt to feel and say, 'We are not in a nunnery,' nor should they be.

29. "Such are the nuisance of ordinary visitors, and the greater nuisance of extraordinary visitors, that I think, if it were possible to make the rule that no visitors are allowed, it would be a great gain.

30. "But at all events, nurses and

head-nurses should only be permitted to receive visitors on certain days and hours of the week, and those hours and days should be strictly kept to. In military hospitals a still more rigid rule will be necessary.

31. "No discharged patients, however well conducted previously, should be allowed to visit the wards.

32. "Have no occasional wards, or wards for accidental or peculiar patients."

33. To the question of the Royal Commissioners, appointed to inquire into the regulations affecting the sanitary condition of the army—"Are there not matrons in all the best civil hospitals?" Miss Nightingale replied, "In all that I am acquainted with."

Respective Duties and relative Position of Nurses and Orderlies.—1. "The administration of diets and of medicine, the making of poultices, the application of leeches, blisters, and minor dressings, the management of the ventilation and warming of wards, should always be in charge of the head-nurse.

2. "Under her, the cleanliness of the ward, bed, bedding, and utensils of the patients, as well as their personal cleanliness, the fetching of diets, the warming and ventilation of the wards, are to be attended to by the orderlies, but always under the nurse's surveillance; and she is to have the power of reporting disobedience on their part.

3. "The best class of men to be recruited for the medical staff corps are discharged soldiers or civilians of good character; they should always be men who can read and write.

4. "If they are to nurse, they should be instructed in the duties of nursing, as also in those of cleaning, etc., by head female nurses, who understand these things. To the superior ranks, a few simple anatomical lectures might be given by the medical officers.

5. "Dispensers must, of course, be suitably educated, if they are to dispense.

6. "The proportion of orderlies should not be less than one to every seven sick, where there is no head female nurse. I am not speaking of convalescents.

7. "Where there is a female head-nurse, but no lifts, or supply of hot and cold water all over the buildings, still one orderly to every seven patients will not be too much. On an average, these two appliances make the difference of one orderly's duty to a ward of thirty sick.

8. "Again, a ward of thirty sick, with these appliances will be better served by three orderlies and half a nurse (for one head nurse could see after two such wards), than a ward without the appliances could be by four orderlies.

9. "The proportion of severe cases in military hospitals being generally much smaller than in civil ones, one nurse could overlook two wards of thirty beds, provided they were on the same floor; but in all other respects the wards should be quite separate.

10. "No man should be kept on duty in a ward more than twelve hours altogether. Watches of four hours are good, as in the naval service. But this is a question which the proper military surgeons can alone decide.

11. "Twelve hours for the orderly to be off duty are not at all too much.

12. "On an average, all men and women, after a day of labor, require a good night's rest; in the long-run, and when they do not have it, either health, efficiency, or sobriety, or all three, go.

13. "A strong man is no exception to the rule; for if made to do night-duty after a laborious day, he will either go to sleep, or drink to keep awake, or he will become knocked-up before his time. It is therefore sound economy to give watchers sufficient sleep.

14. "You will get more work, and get it longer, out of the man by giving him twelve hours on duty and twelve hours off. It is better for him to have eight than seven hours' sleep; and one or two hours for exercise and fresh air each afternoon, or each alternate afternoon, make a man last longer than going to exercise himself in some tap.

15. "Supposing regular night-duty required in a ward of thirty men, supplied as above, and served by half a nurse and three orderlies, it might work thus: the principal medical officer will decide whether the same orderly should do the night-duty for a week, or the three on successive nights; probably the latter.

16. "The orderly might come on night-duty at nine P. M., and remain till nine A. M., thus taking his share in the heavy morning work of cleaning the ward, etc. A large ward got into thorough order by nine A. M. is in very good time.

17. "A nurse, whether male or female, watching and fasting in a ward from nine to nine, or even from nine to six, would either soon be unfit for duty, or put drams in his or her pocket, or doze through the night. I think, therefore, that a night-ration for night-watchers is indispensable.

18. "It should be arranged that the nurses who sleep before and after the watch may be enabled to do so quietly. This is by no means always attended to, either in civil or military hospitals."

19. After describing the uncertain arrangements for nursing in our military

hospitals, Miss Nightingale concludes: "All this refers to things at home, not to war-time, nor to any emergency. Upon each and all these systems, or no systems, it is hardly necessary to make any comments.

20. "There should be a ward-master for every five or six wards, whose whole business should be to see to the regulations and discipline of the orderlies, and to the enforcing obedience to the orders of the nurse.

21. "It is obvious that if the nurse is not in authority in regard to all that concerns the patient, her duties will become impossible; but if she is in authority, the orderlies will willingly obey her.

22. "It should, therefore, be compulsory that she should report a refractory orderly to the ward-master, or to the captain of orderlies, if such an officer be created.

23. "The ward-master should be in charge of all returns, accounts, statements, diet-rolls, etc., so as to set the nurse completely at liberty to attend to her ward."

STATISTICS OF HOSPITALS.

"The sickness to which mankind is liable," says Dr. William Farr, "does not occur at any one time or age, but in an interspersed manner over the lifetime of each person. The constant quantity of sickness is kept up by a succession of diseases attacking the body at intervals and in paroxysms, which, however irregular they appear in a limited sphere of observation, are really definite in number, and separated by definite spaces.

2. "As a certain order is preserved in the performance of the healthy functions, so their derangement, in similar circumstances, also observes an order and regularity of succession.

3. "To accuse the human frame of perpetual malady is as ridiculous as to attribute, with some theological writers, unintermitting wickedness to the human heart; but if every alteration of the multiplied parts of the human body, every ransient trouble of its infinite movements, every indigestion in man, and every fit of hysteria in woman, were reckoned, few days of human life would remain clear; and if the same scrutiny were extended to the state of the brain, the world may very civilly be sent to Anticyra—*naviget Anticyram.*

4. "In determining the quantity of ickness, and the attacks of disease, the lighter affections are therefore passed ver; as, whatever difference there may e in the representation and expression, is probable they have a tolerably constant relation, in the same class of society, to the severer cases recognized, and directly diminishing production by putting a stop to labor.

5. "Men placed in the same circumstances, appear equally liable to an attack of sickness between 11 and 60 years of age; 100 of the London laborers, in each of the decennial periods, 20-30, 30-40, 40-50, 50-60, had nearly 23.5 attacks of sickness annually; the highest number was 26.4, the lowest 22.4. A closer agreement could not, considering the extent of observation, and all the accessory circumstances, be expected.

6. "*The sick-time increases with age in a geometrical progression.*—If, therefore, the number of attacks at each age be the same, the duration of each attack will increase in the same ratio; and conversely, if the duration of the cases and sick-time augment at the same rate, the number of attacks at every age will be equal. Any two of the elements being given, the third may always be deduced from them.

7. "Again, if the mortality of the attacked increase at the same rate as the mortality of the entire population, the proportion attacked at every age will be the same. Among the London laborers the mortality between 30-40, 40-50, was 1.48, 2.43, in 100 living; the mortality among 100 attacked was 6.5, 10.4. Now 1.48 is to 2.43 very nearly as 6.5 is to 10.04; and it results from this, that the attacks, whatever their absolute number may be, whether 22 or 52, were the same in both periods.

8. "We pass over several important applications of these facts to practical medicine, and to practical statistics, where, as in trigonometry, two of the elements of calculation can frequently be measured when the third is only attainable indirectly; expressing a hope, however, that they may be made available in the next census to throw much light upon the sanitary state of different classes of the population.

9. "External circumstances have the greatest influence on the attacks of diseases; age and the internal state of the body determine their mortality and duration. When the people of this country are placed in destructive agencies, these, like balls in battle, carry them off, by attacking a greater number; they also add to the fatality of the attack; but after a man is seized, age and vital tenacity, exclusively of medicine, are the great modifiers on which his life and sufferings depend.

10. "In epidemics the attacks generally become much more fatal at the same time that they are more numerous.

11. "When slighter and ephemeral cases are corrected, and organic diseases

are excluded, the duration of cases among the adults does not, according to the returns of the dock-yards, exceed twelve days."

12. Two reports of a Committee of the Council of the Statistical Society of London on hospital statistics have been published in the 5th and 7th vols. of the Journal of this Society. The information contained in the two reports is elementary and suggestive, rather than conclusive; and of this circumstance the reporters themselves would seem to be aware; for they state that "the tables which are here brought together must be regarded rather in the light of materials placed in a convenient relation to each other for the purposes of comparison, than as leading to any broad inference; or as being in themselves sufficient for the establishment of any important truths." Such materials, however, the Committee reports, "often derive an unexpected value from some inquiry which does not spring directly out of them." The difficulties and uncertainties here hinted at arise altogether from the want of simplicity and of method in the hospital records. Such being the case, we must have recourse to ascertained principles, and to such facts as may be within reach.

13. Any attempt to extend the present investigation farther back would be but a waste of time, reliable statistics being, even up to our day, hardly attained anywhere in hospital polity. Scarcely anything is known of the death-rate in hospitals during the first half and more of the last century, when, in fact, the hospitals generally throughout Europe were little better than lazar-houses.

14. Dr. Farr, speaking of the public institutions of London, says, that in the quarter ending March 31, 1850, which may be taken as a fair average, 40,783 inmates were contained in them; "namely, on an average of the two periods given in the table, 3579 in the military and naval asylums, 670 in military and naval hospitals, 23,972 in workhouses, 3067 in hospitals for the treatment of common diseases, 3849 in lunatic asylums, and 5435 in prisons. Of 10,000 inhabitants, 108 are in workhouses, 24 in prisons, 17 in lunatic asylums, 14 in hospitals; 183 in one kind of public institution or other. In other words, 1 in 93 of the inhabitants are in workhouses, 1 in 726 in hospitals, 1 in 578 in lunatic asylums, 1 in 410 in prison."

15. This is but a general view; yet even "the most general view of the public and charitable institutions of one of the greatest cities in the world, cannot fail to be as useful as it is interesting."

16. "The fourteen general hospitals of the metropolis," says the Society's Report, "admitted into their wards in the course of a year 33,453 in-patients, and treated as out-patients and casual sufferers 313,061 more, making a total of 346,514 patients in a year.

17. "The thirty-six special hospitals and asylums received in the year 12,355 in-patients, and treated 56,068 out-patients, and, including 19,636 patients not distinctly specified as in- or out-patients, a total of 88,059.

18. "The general and special hospitals taken together received 45,808 in-patients, and treated 369,129 out-patients, making a grand total of persons relieved of 434,573, including the 19,636 not classed.

19. "Forty-two general dispensaries give a return of 211,016 out-patients treated in a year.

20. "The eighteen special dispensaries return 21,862 as the number of patients attended in a year.

21. "The general and special dispensaries taken together accordingly give a return of no less than 232,878 patients treated either at their own homes or at the institutions themselves, in the course of the year.

22. "In Paris," says Miss Nightingale, "an Annual Report of Hospitals is published; but the only useful statistical information to be gleaned from it is the number of sous each patient has cost. For, although it gives the number of adults, male and female, and of children, who have been admitted and who have died during the year, yet this in itself tells little.

23. "If the hospitals of London and Paris would give us the information contained under the eight following heads, so important would be the knowledge thereby conveyed, that it would be worth while to go back for many years to construct such tables, and to continue the same forms hereafter:—

i. "The numbers admitted for each decennial period of age for each sex per annum.

ii. "The numbers, similarly arranged, remaining in hospital at the end of the preceding year.

iii. "The numbers dead for each sex at each decennial period of age per annum.

iv. "The numbers discharged cured, similarly arranged, per annum.

v. "The numbers discharged incurable, similarly arranged, per annum.

vi. "The numbers remaining in hospital at the end of the current year, similarly arranged.

vii. "The *diseases* remaining, admitted, died, cured, discharged incurable, and remained, for each sex and each decennial period of age, per annum.

viii. "Duration of cases similarly arranged.

24. "An ill-constructed hospital will certainly produce a high rate of mortality; but it would be an error to conclude that the death-rate is in every case an accurate test, since a high rate of death will sometimes proceed from causes independent of structural defects. In a town where people are much employed in machineries and foundries, its hospitals will necessarily receive a larger proportion of severe injuries than those of another town where the laboring classes are differently employed."

25. "It is of great importance," says Dr. Farr, "for medical men to know the average number of deaths in all cases that come under their care, in order to judge of the remedial influence of medical applications. The hospitals furnish some, although inadequate, information on this head. The sanability of the sick decreases in large cities.

26. "The rate of mortality varies in the progress of cases to their termination. It has been found that the ratio varies according to a mathematical law; describing a regular curve, which can be calcu-ated; the results observed, and calculated, agreeing with great exactness. The law has been investigated in cholera and mallpox.

27. "Mr. Edwards first showed, from ables published by Dr. Southwood Smith, hat the mortality of the fever patients in he London Fever Hospital, between 15–0, increased every year, at a rate meas-red by a constant (1.03) discovered by im, and applied to the construction of ables of mortality. He also first an-ounced that if the mortality of all the atients increased in the same ratio, the umber at each age between 15 and 60 ust be the same; and, moreover, that s the amount of sick-time increases as he mortality, the duration of each case ill increase in the same ratio.

28. "After much suffering, and much ruggling, in the last stages of illness, in eakness and in poverty, great numbers re carried to the London hospitals and workhouses. The division of the deaths the population of such institutions for e reception of the sick naturally ex-bits a high ratio; and the resulting ortality is very different from that which e whole population exhibits. Thus ere are districts in England in which e annual mortality does not exceed 17 1000; in all England the annual rate mortality was 22 in 1000; in London, 1838–44, the annual rate of mortality s 25 in 1000; in the first quarter of 1850 it was at the rate of 24 in 1000 annually; in the same quarter, the mortality in the public institutions was at such a rate that if it continued uniform for a year, 230 would die to 1000 inmates. The mortality was 23 per cent."

29. Referring exclusively to the general hospitals of the metropolis, "the annual rate of mortality was 82 per cent.; in the consumption hospital 82 per cent.; in the fever and smallpox hospitals about 302 and 304 per cent.; in the lying-in hospitals the mortality of the women and children has not, this quarter, been distinguished. No inference should be drawn from the return in respect to the mortality of particular hospitals; thus, as at King's College Hospital, the mortality may be high from patients having been received in a dying state, or from an accidental concurrence of circumstances; or the mortality may be low from the removal of patients in the last stage of illness. It is well known that the mortality is not so high among surgical as it is among medical cases. The mortality in the military was lower than in the civil hospitals.

30. "The annual rate of mortality in lunatic asylums was 13 per cent. The rate in Bethlehem was 7 per cent.; in other asylums the mortality varied from 13 to 22 per cent."

31. We have recently had much discussion on the mortality of the London hospitals relatively to each other, with comparisons also between these last and the death-rates of the hospitals of Paris; in which, owing chiefly, it is said, to differences of race, constitutional strength, and to the comparatively low diet of the French people generally, sick as well as healthy, the losses are uniformly higher than amongst public patients treated within the United Kingdom. It is found, however, that a comparison of mortality of one general hospital with that of another, within any given city, is surrounded by so many sources of fallacy that no reliable conclusions can be obtained. It is different in the instances of lying-in hospitals, whose death-rates afford certain material for comparison.

32. "We possess," says the Lancet, "something like a standard by which to judge the normal and unavoidable risk of a woman in childbed. If that standard be much exceeded, the inference that the patients are subjected to some unusual cause of disease is perfectly logical."

MORTALITY OF HOSPITALS.

What hospital mortality may become through hospital mismanagement, we may learn from many records, civil and military; but chiefly from the records of the

British army. In the Crimea alone the mortality was only short of the total loss of the original force, composed principally of old soldiers. Younger men were sent to replace them, but they died in still greater numbers, until measures of sanitary precaution were applied to the camp, the transport, and the hospital. Under neglects of every kind 18,000 men perished, who might easily have been saved. Under the system of neglect two men died at Scutari out of every five, and one died at Koulali out of every two admitted into hospital. Under proper sanitary regulations the mortality sank to a nineteenth part of these proportions.

2. So sensible was Dr. William Ferguson of the dangers of ill-arranged hospitals, that he declared they would destroy an army faster than any government could recruit it.

3. "In the infancy of knowledge, when Christian benevolence provided for the sick and destitute, and when it was also the sole foundation of the work, hospitals were built in situations and on plans which were far from realizing the intentions of their founders. Mere shelter, food, and attendance were to be afforded to as large a number of sufferers as possible. In times of pestilence, the buildings would be crowded to excess, as we have seen in the case of the Irish workhouses during the famine of 1847. And who can tell how much of the dire loss of human life in the Middle Ages, and during the great Irish calamity alluded to, was due to benevolence misdirected?

4. "One of the most striking illustrations of the results of absence of knowledge on those subjects is afforded by the experience of the Hôtel-Dieu, at Paris. By the statutes of its founders 'all applicants' were to be 'admitted.' It had 1200 beds, and toward the end of the last century these beds used to receive, at the same time, from 2000 to 5000 sick; and during epidemics as many as 7000 have been in the building at one time. From 20,000 to 30,000 sick passed through the hospital in one year, about 25 per cent. of whom were carried to the cemeteries. In the other hospitals of Paris the mortality was about 12½ per cent of the sick.

5. "The excuse," says Miss Nightingale, "for the enormous mortality of the Hôtel-Dieu was the same as is put forward by ill, and even by many well-intentioned persons at the present day for the high rate of mortality in civil hospitals, and, during war, in military hospitals, viz., that only the worst cases were sent there, and that they were sent only to die. The frightful overcrowding and bad ventilation, with the absence of every sanitary precaution, were, however, the real causes of the catastrophe in the Hôtel-Dieu, just as the frightful overcrowding, and want of ventilation, the defective drainage, and want of cleanliness, were the causes of the catastrophe at Scutari."

6. Much discussion, followed by careful investigations, resulted upon both calamities; and, in the instance of the Hôtel-Dieu, eventuated in the introduction into France of vast improvements in hospital construction and management. It will be well if the experiences of our own hospitals shall lead to similar results; and, as to the example of Scutari—and we have had many such—it is to be hoped that its history may also lead to some real and permanent improvements in our military system, as well as in our military hospitals.

7. The truth is that, up to this hour, governments, hospital trustees, and committees, are too apt to conclude that they have done all that is requisite when they have provided "the very best professional advice and assistance that can be obtained;" and so the enormous mortality of hospitals has come to be considered as unavoidable, merely indicating the percentage of mortality inevitably resulting from disease.

8. "But nature is never to blame. If the cases be bad as possible, all the more necessity is there for care in placing them where they may have a moderate chance to recover. To place patients in musty wards is simply to kill them, with the addition of torture. The great army-surgeon, Sir John Pringle, knew this quite well when he asserted that hospitals were amongst the chief causes of the mortality of armies. We may safely extend this remark, and say that badly constructed civil hospitals, and other charitable institutions, increase the mortality of towns and districts. We may take for granted, that no hospital ought to yield a mortality on its sick treated of seven to ten or eleven per cent., as is the case with so many of our existing metropolitan hospitals. A certain percentage of death is inevitable, but not a percentage such as this."

9. Within these few years an inquiry into the comparative mortality of the hospitals in London with each other, and with those of Paris, has been instituted in our medical periodicals; but the difficulties, as shown by Dr. Guy, are such as to render all such comparisons at present useless, or nearly so.

10. From all the calculations that could be made, Dr. Guy states that "the inhabitants of Paris are more prone to fatal diseases, or that they are exposed to more fatal local influences, or that the two unfavorable conditions are in their case united.

11. "We may safely assume that the inhabitant of Paris is a worse subject for

hospital treatment than the inhabitant of London; and if the hospitals of the two capitals could be on a par in respect of all means of successful treatment, their patients would not enter them on equal terms.

12. "This, then, is one difference between the inhabitants of London and Paris. Another, and a more important difference, and one which must have a very powerful effect on the hospital mortality of the two capitals, consists in the widely different provision made for the care and treatment of the indigent, the insane, the sick, and the infirm in London and Paris respectively.

13. "Though the destitute part of the London population is provided for in sickness in the wards of our unions and workhouses, a certain small portion of that very poor population gains admission into our London hospitals. It results that probably one in fifteen of the inmates of London hospitals belongs to that destitute class for which our workhouses are intended; the remaining fourteen consist chiefly of poor persons to whom the term "destitute" could not be properly applied, and of respectable working men and artisans, with a small number of tradesmen, and a few of better station.

14. "But the task of providing for the sick poor in the more severe class of maladies is performed by our hospitals in part only; a very considerable number of the worst cases of illness being treated at the homes of the sufferers themselves by the physicians and surgeons of our dispensaries.

15. "Nor ought it to be forgotten by any inquirer into the mortality of our London hospitals, that the hospitals themselves consist of at least three distinct classes. We have our general hospitals, our class hospitals, and our special hospials—hospitals, endowed and unendowed, or the treatment of diseases of the more evere class, with few exceptions, and without distinction of sex or age; hositals for women, for children, for seamen, for foreigners; hospitals for insanty, consumption, cancer, deformities, kin-diseases, and venereal maladies.

16. "Hence it happens that the wards f a general or,mixed hospital present by o means a faithful picture of the more evere accidents and diseases of the poplation in the proportions in which they ccur. Most cases of smallpox are taken o the smallpox hospital; many cases of ver are removed to the fever hospital; he insane find a hospital and a home at Luke's or Bethlehem; for consumpve cases there are two special hospitals; veral special maladies, such as cancer, tula, diseases of the eye, diseases of the in, deformities, and venereal diseases, have special hospitals provided for them; and whole classes of the population, such as women, children, seamen, and foreigners, have also their own special hospitals.

17. "A minute comparison of the mortality of the London and Paris hospitals is neither necessary nor possible. The first and most fatal obstacle to such a comparison is offered by the fact that the Parisian hospitals are the recipients alike of the destitute and of the poor, so that they discharge the twofold function of the London workhouse infirmary and the London hospital.

18. "A second peculiarity, which is not without effect on the rate of mortality in the two [sets of] hospitals is, that the Parisian are supplied by the central administration with cases for which they are compelled to provide accommodation, so that they are subject to be greatly overcrowded in unhealthy years and seasons; while in London the governing bodies of our hospitals are under no such compulsion, and receive a number of patients, determined not by the wants of the population, but by their own resources.

19. "If to the two leading causes affecting the rate of mortality of the Parisian hospitals are added the two facts, that the hospitals which are best entitled to be considered as 'general hospitals' receive from the central administration those cases in excess which their physicians and surgeons may be most desirous of studying, and that the special hospitals in the two capitals do not admit of being compared with each other, the uselessness of comparing hospital with hospital in the two capitals respectively, or even comparing the aggregate of the two hospitals of the one with those of the other, must be quite obvious.

20. "The remarks which apply to a comparison between the hospitals of London and those of Paris must also apply to a like comparison between the hospitals of London and those of other considerable European cities. Each city will have its own special arrangements for the treatment of the sick poor—its own special rules for the admission of patients to the benefits of its medical charities.

21. "Nor is the case greatly altered, except in degree, when we come to compare the hospitals of London with those of our English provinces. Each metropolitan hospital has its own local and its remote sources of supply. It has its accidents and its acute cases from the immediate neighborhood, and it draws from the environs of London itself, and from more remote rural districts, its surgical cases for operation, as well as some of

its worst chronic cases for medical treatment. The larger provincial hospitals have perhaps similar sources of supply and medical and surgical cases of like severity."

22. The chief considerations, "and they enable us to arrive at results, highly probable, if not absolutely certain, of the highest interest to all who sincerely desire to understand the true causes of hospital mortality," will, according to Dr. Guy, be found under the following heads:—

(*a*) Locality.
(*b*) Site and structural arrangements.
(*c*) Space, light, and ventilation.
(*d*) Size of hospital.
(*e*) Medical and surgical cases.
(*f*) Males and females.
(*g*) Selection of patients.

Dr. Guy "hopes to have an early and more suitable opportunity of establishing by a more considerable array of figures the important fact that the great leading cause which determines the mortality of hospitals is the selection of patients—a cause which, at the point of sanitary excellence our London hospitals have now attained, appears to him to be the real determining cause of a high or a low death-rate."

To demonstrate to the satisfaction of the profession that any one cause (structural arrangement, bad or good, or the selection of patients, namely) will prove the great leading cause, or the real determining cause, of a high or a low mortality in hospitals, is what I fear we may not hope to see speedily effected; but the difficulty ought not to deter us from the prosecution of so important a course of investigation.

Dr. Bristowe and Mr. Holmes, the authors of the Report on the Hospitals of the United Kingdom, comprised in the Appendix to the Sixth Annual Report of the medical officer of the Privy Council, have given it as their opinion, derived from personal inspection of nearly all the hospitals in the British islands and in Paris, that the causes of the great difference in death-rates in rural and urban hospitals are to be found chiefly, if not entirely, in the different kinds of cases admitted. A comparison of the admission-books of the hospitals and of the patients actually in the wards at the time of their visit, has left no doubt on their minds that in country hospitals and infirmaries the medical cases (which at our large metropolitan hospitals are always far more fatal in proportion than the surgical) are, for the most part, trivial or chronic, and furnish comparatively few deaths in hospital. This circumstance, according to them, gives a fallacious appearance of healthiness to institutions which really are less fit places for the treatment of disease than the large hospitals of great cities; but that appearance of healthiness is obtained by neglecting or refusing to provide for the relief of the necessities of the public by the admission of fevers and urgent cases. No public hospital, according to these inquirers, is faithfully discharging its duty, which refuses to undertake the care of those persons who are most in want of it—those afflicted with the gravest form of disease—*i. e.*, the infectious or epidemic maladies. The chief reform, therefore, which they suggest, is the abolishment of the rules whereby the benefits of hospitals are restricted, in a great measure, to the acquaintances and dependents of the subscribers, and the more free admission of fevers and acute medical cases. This reform, however, as they intimate, will be accompanied, not by a diminution of the death-rate, but, on the contrary, by its considerable increase. They regard the presence of a low death-rate in any general hospital as a proof, or at any rate a very strong presumption, that such a hospital is failing in its public duty, by restricting its charity to those of the sick who are little in need of it. While agreeing in the main with those sanitary reformers who urge the importance of pure air, cleanliness, and free ventilation, these reporters adduce evidence to show that the number of cases of disease generated in hospital is not large, if estimated by the number of deaths so occasioned, which at all our large metropolitan hospitals form a very insignificant proportion of the total deaths. If this is so, it is idle to expect that any structural improvements or any alterations in the details of hospital management would materially affect the broad result—the death-rate. This could only be accomplished by such changes in medical and surgical treatment as would affect the mortality of the diseases treated. The Medical Officer of the Privy Council himself, Mr. Simon, has in the body of the Report expressed his concurrence in the main views enforced in this document, which, he says, "gives a substantially just relative appreciation of the present hospital-system of this country."

The Finance of Hospitals.

I had hoped to escape from this subject as intricate and perhaps unsatisfactory in its nature; but the question met me at every turn, and I could not avoid it. It will be seen that amongst the best men of our profession, past and present, whether pure philanthropist, or philanthropist and man of business, economy in expenditure has taken the lead in their hospital arrangements. It even precedes the attribute of order. The very existence of an hospital implies a rigorous regard to expenditure; for who can contemplate an extravagant hospital as other than the worst kind of "Red Lion" for invalids—as a house which must fall on the first day of reckoning. However unsatisfactorily the doctrine that "economy is the life of the army" may be carried out in practice in this country, certain it is that economy is the only sound life of charitable institutions. It precedes all other considerations. In the history of our military expeditions, hospital finance rises continually into view, either as unworthy parsimony or as enormous and unnecessary waste. The proper regulation of this matter is therefore one of the most important of preliminaries in all hospitals, whether civil or military. The waste of hospital funds is no small part, for instance, of overcrowding, by causing every case of sickness or of wound to linger in hospital so much longer than would otherwise be needed.

2. The sting of hospital finance, as of general taxation, is wastefulness; and there must therefore be a power to control and direct expenditure, and to see that money is well spent.

3. But there is another contingency to be guarded against. Looking to the future, there is some reason to apprehend that even charity may be abused amongst us; that our metropolitan charities may become too numerous, so as to exceed the real wants of the population; that institutions of most excellent design may eventually have to relieve each other, for want of other objects.

4. Of charitable institutions, there are in this metropolis, according to the "First Report of the Committee on Beneficent Institutions," about one thousand two hundred; the medical charities alone relieving upwards of six hundred thousand patients, as in-and out-patients of hospitals.

5. The sums contributed for the support of the medical charities of London and Paris are, by one calculation, as follows (the disproportion representing probably the ratio of the two populations):—

London.

Income of medical charities .	£308,520
Poor-law	842,380
	£1,150,900

Paris.

Expenses of l'administration générale, year 1853 . .	£560,853

6. *General Hospitals.*—"The fourteen institutions belonging to this class possess an income from realized property to the amount of 109,687*l.*; annual subscriptions amount to 17,091*l.*; their donations to 16,636*l.*; their legacies to 10,206*l.*; and their miscellaneous sources of income to 1996*l.* The total income of all these hospitals from every source is 155,616*l.*; and the annual contributions of the public amount to 45,929*l.*

7. *Special Hospitals.* — "There are thirty-six of these institutions, possessing an aggregate income of 117,218*l.*, exclusive of 79,988*l.*, comprised in the fifth column of the table, headed "Poor-law relief." Of this sum of 117,218*l.*, endowments and realized property yield 27,140*l.*; annual subscriptions, 12,081*l.*; donations, 28,702*l.*; legacies, 18,993*l.*; miscellaneous sources of income, 15,385*l.*; and sales and contributions by patients or their friends, 11,333*l.* The difference between the sum of these specified sources of income (113,643*l.*) and the grand total of 117,218*l.* consists of sources of income not distinctly specified in the reports of the several institutions.

8. "It will be seen that the income of the general and special hospitals taken together amounts to 155,616*l.*, added to 117,218*l.* or 272,834*l.*"

9. *General Dispensaries.*—"Of these institutions, of which there are forty-two in number, the income from all sources is nearly 21,000*l.* The exact sum is 20,988*l.*, made up as follows: endowments and realized property, 2282*l.*; annual subscriptions, 8777*l.*; donations, 7746*l.*; legacies, 944*l.*; miscellaneous sources, 126*l.*; and sales and contributions from patients and their friends, 1113*l.*"

10. *Special Dispensaries.*—"There are eighteen of these institutions, of which the annual income amounts to 8064*l.*, thus distributed: endowments, etc., 2098*l.*; annual subscriptions, 3146*l.*; donations, 1792*l.*; legacies, 733*l.*; miscellaneous sources of income, 168*l.*; and contributions from patients and their friends, etc., 127*l.*"

11. *Nurses' Training Institutions.*—"These useful institutions, which are auxiliary to our hospitals, have an income of 4740*l.*, derived chiefly from payments made by wealthy persons for the services of the nurses trained by the institutions. They derive 3317*l.* from this source; they have 79*l.* of income from realized property; 548*l.* from annual subscriptions; and 796*l.* from donations."

12. *Samaritan and other Funds connected with Hospitals and Dispensaries.*—"These funds have an aggregate amount of 1882*l.*, of which 667*l.* is derived from realized property; 159*l.* from annual subscrip-

tions; 758*l.* from donations; and 298*l.* from contributions in aid, etc."

13. *Poor-Law Medical Relief.*—"The salaries of medical officers and dispensers, and the charges for such drugs and medical and surgical appliances as are occasionally provided by the guardians, in addition to those salaries, amount to 28,776*l.*"

14. *Cost of Maintenance of Pauper Lunatics.*—"This amounts to the very considerable sum of 79,988*l.*"

15. *Vaccination.*—"The sum paid for vaccination—a measure of precaution belonging to a different class of charities from those now under consideration, but not easy to separate from them—is 4292*l.*

16. *Summary.*—"The annual income of the several medical charities, of such portion of the medical relief under the Poor-law as admits of separation from the general expenditure, of the cost of maintenance of pauper lunatics, and of vaccination, amounts, as will be seen by the following tabular statement, to 421,576*l.*; of which 308,520*l.* consists of voluntary contributions, and 113,056*l.* of sums raised by rates."

17. "General hospitals . . .		£155,616
Special hospitals . . .		117,218
Total hospitals . . .		£272,834
General dispensaries . .		21,000
Special dispensaries . .		8,064
Total dispensaries .		£29,064
Nurses, training institutions		4,740
Samaritan and other funds		1,882
Total of voluntary contributions . .		£308,520
Poor-law medical relief	£28,776	
Pauper lunatics . . .	79,988	
Vaccination	4,292	
Total raised by rates		£113,056
Grand total of voluntary contributions and rates		£421,576."

18. "Of the charitable contributions properly so called, about 142,000*l.* is derived from realized property; about 41,000*l.* from annual subscriptions; about 52,000*l.* from donations; and about 31,000*l.* from legacies.

19. "If the population of the metropolis be taken at 2,500,000, the voluntary contributions to our medical charities, including the income derived from realized property, will be at the rate of somewhat less than 2*s.* 6*d.* per head. Taking the same basis of calculation, the annual subscriptions will be at the rate of less than 4*d.* per head, the donations of about 4*d.* per head, and the legacies of nearly 3*d.* per head. But if allowance be made for contributions from persons who are not resident within the limits of the metropolis, even these small sums will have to undergo some abatement."

20. While treating of hospital finance, it is proper to state that the funds of our medical institutions are said, by persons who speak advisedly, to be in course of constant abuse from the admission to their benefits of persons who, by their position and superior means, are undeserving of any charitable relief."

21. To demonstrate the fact, it is only necessary to state that forty-five millions sterling are annually expended, by the laboring classes chiefly, in the purchase of spirits and tobacco! while it is well known to the medical officers of our hospitals that a goodly percentage of the patients derive succor fraudulently, and to the prejudice of the interests alike of the medical officers and of the subscribers to our charities.

22. That the means possessed by daily-increasing classes of laborers and artisans are sufficient, in their years of health, to provide for the necessities of their hours of sickness, and for the infirmities of age, is proved by the readiness with which they join the Benefit-Societies established by public companies and private establishments.

23. By ill-regulated and indiscriminate modes of medical relief, we teach habits of improvidence to the class of laborer and mechanic, and eradicate from their minds the noble characteristic English attribute of self-reliance and self-respect. We do more: by holding out promises of succor, under diseases engendered by debauchery, we encourage the national vice of drunkenness.

24. Our medical charities were not established for the reception of absolute and unredeemed paupers; yet a large proportion of the out-door relief given by our hospitals and dispensaries is thus wrongly diverted. Through want of food and its resulting diseases, they seek for aid, and receive cod-liver oil, sago, and arrowroot; while the Poor-law relief, which is their proper due, is withheld.

25. "Yes," says the Medical Times and Gazette, from whose excellent articles these observations are quoted, "these charities are a sort of sluice, into which the Poor-law authorities turn a large amount of parochial misery, instead of honestly providing for it. What do the bills for cod-liver oil consumed by this class of paupers in our charities really represent, but so much food, paid for by the governors instead of by the ratepayers?"

26. Under a system better ordered, the mechanic, instead of spending the superfluous part of his wages in drunkenness, and in the production of the many diseases which drive him into hospital, would then become an independent man, receiving what in part he had already paid for, and had a right to claim.

27. "A long experience," says the editor already quoted, "has shown to us that the classes of whom we speak are willing and ready to pay the small sum demanded of them—a sum which would equal half the present expenses of our hospitals and dispensaries—provided they could thereby obtain the superior kind of advice they suppose to be had at hospitals."

28. The relief which can be very easily obtained is seldom valued; and this truth applies in an especial manner to the indiscriminate out-door relief which offers food of insufficient nature and amount, in the shape of medicine, to starving paupers.

29. Three great endowed London hospitals are mentioned[1] as possessing each an annual revenue, rapidly increasing, of 40,000*l.*—thus placing at their joint disposal 120,000*l.* per annum. The three institutions together promise a maximum of 1700 beds; requiring for the annual maintainance of each bed 30*l.*, or an aggregate of 50,000*l.*

30. On this calculation, the large sum of 70,000*l.* is left to be annually applied o the relief of about 200,000 out patients; ach of them costing the institutions about ix shillings a head—an extravagant sum or this department of service. This sys-em requires a revision, lest it degenerate nto a waste of the revenues of those reat charities, crippling their usefulness n other and better directions.

CONVALESCENT HOSPITALS.

No system of hospital arrangement, ational or metropolitan, civil or military, an be regarded as in any way complete, hich does not comprehend the supple-entary establishment of convalescent ospitals. All who are acquainted with r civil hospitals, especially those in owded cities, know how many patients turn home to die, for want of an asylum here convalescence may be promoted d matured into health—where pure air, ntle exercise, and regulated diet may mplete what the surgeon and the phy-ian have begun. In our hospital ar-ngements, it is to be feared that we ve been trusting too much to drugs, d too little to the influence of pure air.

2. There are notices of remote date in various countries, as Spain and France, of convalescent establishments as attached to, and for the relief of, general hospitals; and we find excellent notices, although not of so early a date, in our own country, such as those of a Society established in 1791, in connection with the London Hospital. They were founded on the works of Howard, the philanthropist, and the principle of their institution professed to be: "Take care of him; and whatsoever thou spendest more, when I come back, I will repay thee." Here we have, in fact, the principle of all sanitary arrangements, which, by a universal and beneficent law, repay themselves; a result so beneficent that it should be ever kept before the public eye.

3. Charity should not be exclusive or limited in its application to distress, nor should its objects in relation to disease fall short of a complete restoration to health. Hospitals are a practical example of that charity which has been compared to the bounty of heaven, and to the hand of the Creator, which is never closed.

4. By charity we understand a virtue which, like generosity, supposes the sacrifice of personal for foreign interests. Charity is not only a duty of humanity, but more; one of the most pointed obligations of society towards some of its members, to whom it owes everything, when they can do nothing for themselves. This is not said with the view to deprive governments of their merit when they occupy themselves with public charity; on the contrary, to speak of the duties of governments is to show them, if not the only, at least the most solid, title of their glory.

5. All we can wish, as regards the poor, is, that they accept and enjoy, without the fear of humiliation, the succors which charity offers them; and for this it is only necessary that they know they have a right to those succors.

6. It is doubtful if any estates were ever devised, or any money bequeathed, which bore richer fruit or produced greater blessings than hospital endowments. When it is remembered that in those establishments any poor invalid or sufferer, with no claims but his sufferings, finds the best treatment, the best food, the best advice that can be given—all indeed which the most unbounded wealth could buy—it will be seen how truly they reflect honor upon the country.

7. But hospitals are not complete or perfect any more than other human institutions; and one of the greatest wants of our noblest institutions must be reckoned the absence of convalescent establishments. The "desperation," the natural craving for "variety," so graphically de-

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[1] Medical Circular of February 27, 1860

scribed by Miss Nightingale as characteristic of all sick persons, must of itself have proclaimed to the observant physicians of all ages and countries the necessity for convalescent hospitals; that is, for a relief from the horrors of the hospital miasm of the great town system. Miss Nightingale's description of the laboring man who was desperate "to see once more out of the window," and who got on the nurse's back "to see out," is demonstrative of physiological truth, because it is an instinctive impression. The desire for change, for change in everything, physical and moral, which is implanted in our nature, is increased a thousandfold by sickness; and the denial of this instinctive craving is unquestionably a most powerful cause both of retarding convalescence and cure.

8. "An hospital," says Dr. Rollo, of the Artillery, "should be regarded as a place exclusively devoted for the reception and treatment of the sick and wounded; but when convalescence arrives, a change of place and of management becomes necessary to the advancement and re-establishment of health. When the sick begin to feel the dawn of health, the mind becomes sensibly changed, and disgust takes the place of accustomed associations and modes; and hence a disposition is formed inimical to recovery. When this stage arrives, if they are removed from hospital to the place of convalescence, where they are to associate with different persons, to engage in other and new manners, and to be sensible of a complete change of scene and of habit and accommodation, the recovery advances rapidly and proves complete. These observations apply to any description of sick; but more especially to the soldier."

9. Convalescent hospitals are spoken of by Donald Monro as in general use throughout the army in his day, and he lays down excellent rules for their management. How this inestimable aid fell into disuse in the army does not appear. Robert Jackson, writing in 1803, recommends "separate and detached houses," and the removal of convalescents "to other apartments or hospitals." He adds that innumerable proofs occurred in his experience of soldiers "recovering health better and sooner in sheds, huts, and barns, exposed occasionally to wind and rain, than in the most superb hospitals in Europe. Pure air, in this respect, is alone superior to all forms of cure, and to all other remedies without such aid."

10. This great author everywhere speaks of "relapse as the leading cause of mortality in general hospitals. . . . The effect of accumulation is evidently to corrupt the air, and thus to generate an artificial malignity; life is lost, and the cure is protracted; independently of which the military qualities of the surviving soldier, as depending on discipline and impressions of energy from example, are impaired, if not totally destroyed."

11. In hospital the soldier is under a necessary restraint; and were he discharged from it immediately on the subsidence of disease, to inhabit the common barrack, he would feel and act as the schoolboy at his vacation, and enter with all the recklessness of his nature into enjoyments the most injurious to his health; and hence frequently those relapses so much more dangerous than the original disease.

12. The convalescent hospital is therefore a stage in the process of cure, intermediate between the hospital and the home of the citizen and the soldier. In either case the sick and convalescents are gradually and surely brought back to their habits of health, and the duty of the physician, whether civil or military, is duly performed.

13. In the convalescent hospital there must be separate and equally well-ventilated apartments for the refreshment of sleep and for that of meals, besides covered ways for exercise in bad weather, and open spaces for exercise in fair weather. The scale of diet must also rise with the advance towards health.

14. The miasm was so concentrated in some of the Italian hospitals that, out of fear of its effects, convalescents were not deemed safe in their neighborhood; the patients were therefore sent into the country and lodged in separate houses. Where practicable, a certain number of convalescent hospitals should be constructed on the seaboard.

Postscript.—Perhaps the most complete institution of the kind here referred to is that founded in August, 1857, at Vincennes, by the Emperor Napoleon III., and which contains 411 beds. The edifice is composed of a main building, with two long wings, two stories high, with a ground-floor. It has ample garden-ground, basins, and jets-d'eau.

2. In the first two years and ten months of its usefulness this hospital had administered relief to 14,000 convalescent artisans.

3. The central pavilion, Dr. Véron states, contains, on the ground-floor, the chapel, and to the right and left airy dining-halls, having marble tables, commodious seats, and simple service reduced to necessaries. Every object in these refectories is bright with cleanliness.

4. On the first-floor of the central building are the library and play-room; the two wings of the edifice in both stories being subdivided into rooms, each of three

beds, all neatly furnished, and looking to the south. Each patient has the use of a press, with lock and key.

5. Everywhere open air and sun are freely admitted; and even in the storehouses permanent ventilation is maintained; consequently nowhere, even in the best houses, is linen to be found drier or fresher than at the asylum. It is completely inodorous.

6. The convalescents belong to the following categories:—

- (*a*) To the hospitals of Paris and its suburbs.
- (*b*) To charitable boards.
- (*c*) To convalescents from wounds received in the public dockyards.
- (*d*) Members of benefit-societies.
- (*e*) Operatives from establishments paying subscriptions, and whose directors are authorized to send their convalescents to the asylum.
- (*f*) Artisans treated at their own homes on presentation of certificates of convalescence by their medical attendants.

7. The mean duration of the stay at the asylum is twenty-two days. Convalescence from typhus fever is comparatively short, in consequence of the hygienic resources of the institution.

8. In principle, the convalescent remains at the asylum until he is completely restored to health, or declared incurable.

9. The diet is regulated by the director and head-physician of the establishment, the habits of the artisans being adhered to for the hours of meals.

10. At 7.30 A. M. soup is served; and at 10.30 meat and vegetables. At 5 P. M. soup, roast meat, vegetables, and salad or dessert are served; each convalescent receiving a pint of Burgundy wine, and as much bread as he may choose. The head-physician modifies this diet whenever he thinks fit.

11. When convalescents desire it, they are employed in the establishment, receiving wages of from two to five pence per day, and an extra allowance of half-a-pint of wine. Some thus lay by a small sum which proves a useful resource on leaving the asylum.

12. The allowance for food for each patient per day is 11*d.*, exclusive of the general expenses and of firing; the daily cost of medicine for each convalescent averaging $\frac{3}{10}d$.

13. The medical service is complete, and comprises common baths, sulphurous, saline, and vapor baths; the administration furnishing also bandages and such other apparatus as the convalescents cannot afford to purchase.

14. On arrival, and being examined by the house-surgeon on duty, convalescents receive the clothing and linen of the establishment, which usually comprise shirt, greatcoat or smock-frock, socks, nightcap, a cloth cap or straw hat, a napkin, towel, and handkerchief. The linen is changed every Saturday, being washed and ironed in the asylum.

15. A wash-house is established on Bouillon-Müller's system, and comprises a five-horse-power steam-engine, wash-tubs, coppers, a cold-water boiler, a centrifugal-force drying-machine, hot-air drying-rooms for winter, and a drying-field in the open air for summer.

16. Unoccupied convalescents find numerous means of diversion; they have at their disposal skittles, balls, drafts, dominoes, loto; cards are prohibited.

17. The library is open every day from 12 to 4, and contains 4000 volumes and the illustrated journals. The greater part of these books were presented by the Paris booksellers as donations. On the average there are 50 readers a-day; and there have been as many as 96.

18. The bearing and general conduct of the inmates is exemplary; submitting without murmur to the regulations, being polite to each other, and respectful to the officers of the establishment. They are careful of the furniture, garden-flowers, etc., and keep their rooms and passages in great cleanliness.

19. The officers of the asylum of Vincennes are—a director, treasurer, head-physician, and three house-surgeons; six nuns of the order of St. Augustin of Belgium; a chaplain, five clerks, a storekeeper, four overseers and forty subalterns.

20. The head physician has the charge both of the medical and surgical departments; and upon his and the directors' nomination the house-surgeons are appointed by the Minister of the Interior.

21. Sunday, Monday, and Thursday are the days on which relatives and friends are allowed to visit the convalescents; and the parlor or garden may be used for this purpose.

[The general principles of hospital construction and organization, as they are embodied in the foregoing treatise, require neither vindication nor correction. The names of the author and of the authorities which are freely quoted, are themselves a guarantee of the soundness of the views expressed.

Some further consideration, however, may profitably be given to certain practical matters which have lately been brought into view, or to points which have acquired greater relative importance than was formerly ascribed to them. During the time which has elapsed since the publication of the treatise, much has been done and much has been written. New views have been advanced, and old theories confirmed or abandoned. The War of the Rebellion, in this country, and the Franco-Prussian War, have given the means of testing methods of construction and administration of military hospitals upon an immense scale; and the unrivalled opportunities which have been afforded for observing and recording results, have been improved to a very remarkable extent. A considerable number of civil hospitals have also been constructed; and a steadily increasing solicitude has been shown for the best methods, irrespective of mere immediate cost, on the part of those who have controlled public and private charities. Construction has been conducted to some extent in experimental forms; one result of which has been to confirm the view, that excellence is the best economy.

The great and increasing attention that has been paid, of late years, to sanitary science in general, has contributed to advance in this special branch. It would be premature at present to estimate the probable effect, upon hospital construction and organization, of the studies and discoveries which have been made in microscopic science; of the detection of floating organisms in the atmosphere, their identification as germs of structures which are known to exist in association with decay and with diseases, and the observation of the remarkable results which attend their exclusion from wounds and their destruction in and out of the living body; but it has already become plain that attention to *detail* of the most minute description is absolutely necessary, and in fact will hereafter be a fundamental characteristic of success.

One event of great importance in relation to progress in this department of medicine deserves special comment. The trustees of the Johns Hopkins Hospital, to whom was entrusted, by the will of the founder, the task of constructing in the best possible way a large civil hospital in the city of Baltimore, in accordance with his direction "to obtain the advice and assistance of those at home and abroad who have achieved the greatest success in the construction and management of hospitals," selected five gentlemen, of whom the present writer had the honor of being one, each to prepare an essay, and plans embodying their suggestions and advice as to the execution of the trust. These, with an appendix by their architect, were published by the trustees in a handsome volume, which has been supplemented by sketch-plans resulting from collation and comparison of the essays and from further study, and by a lecture printed in the New York Medical Record, and other publications, prepared after a comparison of the sketches with European plans, and consultation with foreign authorities, by Dr. John S. Billings, U. S. Army, who was one of the essayists. All these have been widely commented on and criticized. Dr. W. G. Wylie, of New York, has published a review of the whole, in connection with his Boylston prize essay on Hospitals. A report on Heating and Ventilation, by Dr. Billings, has since appeared. This board of trustees has thus not only obtained the advice they needed, but has made accessible to the public a group of publications which forms quite a comprehensive and practical presentation of the latest and most mature views on these subjects. It will certainly not be the fault of the trustees if this hospital does not surpass in excellence anything which existed before, and the practical result is awaited with much interest.

The first volume of Buck's Hygiene and Public Health, published in New York, in 1879, contains an article on the General Principles of Hospital Construction, by Dr. Francis H. Brown, of Boston, which is followed by a full bibliographical list, extending to the year 1877. The titles of all important works published since that time are to be found in the well-known "Index Medicus."

SITE AND DRAINAGE OF HOSPITALS.

The announcement of Pettenkofer, of the baleful effects of "ground-air," when allowed to permeate dwellings, seems to have excited various amounts of respect and attention. Dr. Stephen Smith, in his essay for the Johns Hopkins Hospital, goes so far as to recommend an elaborate system of *ground ventilation* by means of a heated shaft one hundred and fifty feet high, communicating with special conduits and drain-pipes leading to various depths in the ground! This suggestion, however startling, is a logical result of adhesion to Pettenkofer's views. The facts which his investigations and experiments have demonstrated, are extremely interesting. He states that dry ground consists of air to the extent of one-third, and that this air contains a very large proportion of carbonic acid, as well as other deleterious gases. This air moves from point to point under the influence of the same laws that would govern its movement and diffusion elsewhere; and a rise of temperature in the ground is followed by a movement of the surrounding ground-air towards the warmer point. Thus the emanations from decaying animal or vegetable remains may be conveyed for a considerable distance; and as there is constant exchange and motion between the free and the ground air, due to their difference of temperature, a source of danger would seem to be established. And as the same author has shown a very remarkable degree of permeability in the materials of which dwellings are usually constructed, one is led to wonder how the human race has so long survived these deleterious influences. Indeed he alludes to deaths, and to disease resembling typhoid fever, resulting from gas travelling from pipes in the ground at a distance. This statement is found in his work, Air in relation to Clothing, Dwelling, and Soil, published in 1873. One is led to doubt the relation of cause and effect in these cases when it is remembered that those who, by their occupation, are almost constantly exposed to its influence by breathing illuminating gas, such as the men employed in putting in the service-pipes, do not suffer in health. Life may be destroyed by the presence of a certain large proportion of t in the air, but it does not appear to ave the effect of a slow constitutional oison. The effect of ground air is nuch aggravated, we are told, by the 'ground water" which is also present in nany soils; the rise and fall of which, ccording to Dr. Carpenter, (in Public Iealth, published in 1875), is attended rith a fluctuation between typhoid fever nd malarial diseases. The dangers asribed by these authors to the air and oisture in the soil would seem to be ctually more dependent on the characristics of a site unsuitable in other reects. It cannot be doubted that if nproper material, such as decaying anial or vegetable matter, is suffered to come the foundation of a building, or to ist in its immediate vicinity, the ground ater and the ground air will serve as ady vehicles of mischief; but the best thorities concur in recommending that tention to the *composition* of the soil, is ecessary precaution in selecting a site; d that, unless the ground is so elevated d porous as to ensure that water never nains in it, a thorough system of underainage should be constructed, so as to vent stagnation, and constantly dinish the quantity of water, throughout site and any higher ground that may adjacent. Provision should also be made the prompt removal of the rainfall, less the natural conformation already ures it. A free circulation of air over surface is also to be secured.

he following is a summary of conclus on this subject to be found in Obvations on the Construction of Healthy ellings, published in 1880, by Douglas ton, whose authority in such matters not be questioned.

"1. Clay soils should, if possible, be avoided.

"2. Ground at the foot of a slope, or in deep valleys, which receives drainage from higher levels, should be avoided. It predisposes its occupants, even in temperate climates, to epidemic diseases.

"3. High positions exposed to winds blowing over low marshy ground, although miles away, are in certain climates unsafe, on account of fevers. Indeed, it sometimes happens that a site in the immediate vicinity of a marsh, or other local cause of disease, especially if protected by a screen of wood, is safer than an elevated and distant position to leeward.

"4. Elevated sites, situated on the margin or at the heads of steep ravines, up which malaria may be carried by air currents flowing upwards from the low country, are apt to become unhealthy at particular seasons. Such ravines, moreover, from want of care, are often made receptacles for decaying matter and filth, and become dangerous nuisances. In tropical climates these ravines convey malaria, and occasion aggravated remittent or even yellow fevers, at an elevation which would be otherwise exempt from the action of tropical malaria.

"5. Ground covered with rank vegetation, especially in tropical climates, is unhealthy; partly on account of the amount of decaying matter in the soil, partly because the presence of such vegetation is in itself a mark of the presence of subsoil water, or of a humid atmosphere.

"6. In warm climates, muddy sea-beaches, or river banks, or muddy ground generally, if it be subject to periodical flooding, and marsh land, especially if it be partly covered with mixed salt and fresh water, are peculiarly hazardous to health.

"7. A porous subsoil not encumbered with vegetation, with a good fall for drainage, not receiving or retaining the water from any higher ground, and the prevailing winds blowing over no marshy or unwholesome ground, will, as a general rule, afford the greatest amount of protection from disease that the climate admits of.

"8. To test the healthiness of a site an inquiry into the rate of sickness and mortality in the district will afford valuable information. But care should be taken not to be guided by the mortality alone. The nature of the diseases, and the facility, or otherwise, with which convalescences and recoveries take place, must be also taken into account."

We cannot deny that a certain amount of organic decay or disintegration goes on in all soils; but the influence of porous earth in promoting the process and reducing the results to innocuous and inoffensive forms must not be forgotten. The large amount of carbonic acid found by Pettenkofer must be partly due to this very influence. Experience has been so favorable in the use of tents, with or without a simple permeable wooden floor, for hospital purposes, that it is impossible for those who have been familiar with them to regard the exhalations from ordinary drained soil with much solicitude. In permanent buildings it is a custom much recommended to make the basement floors more or less impermeable by a layer of cement, but the object is to exclude sensible moisture, rather than air. The combination of concrete and asphaltum would be the most reliable material for either purpose. Dr. Wylie, however, in his essay before alluded to, goes so far as to interpose a layer of slate in the piers of masonry which support his hospital pavilions, to intercept the passage of ground air up through them!

The contamination of the soil, and its contained air and water *from the surface*, is a matter much more worthy of attention. With properly constructed drains, however, this becomes a matter of administration; and whatever system is adopted, it should ensure that no waste material of any sort should ever be deposited on the surface. It is even better that the rain which washes the roof and walls of a hospital should be conducted away. All drains should be ventilated, and should be so constructed as to be subject to a flushing process which will prevent the collection of any considerable amount of fermentable material. The availability of the rainfall in flushing drains is obvious; but there is an objection to connecting the rain-water conductors with the drains for the sewage, properly so called, and especially to making use of them as ventilators for such drains, from the great liability of contaminating the air of the wards. Two systems of surface drainage are therefore necessary beside the subsoil drainage before alluded to. First, one to remove the rainfall, which will be sufficiently ventilated by the conductors. The overflow pipes of all tanks of water should, if possible, be turned into this system, and there would be no impropriety in connecting it with the subsoil drainage, if ample allowance is made for its escape. Second, the provision for the sewerage proper should receive very early attention in planning a hospital, and, in fact, it is necessary to hold it in constant respect in the construction. It is known that certain diseases may be communicated directly by means of the evacuations of the body, and by the epidermis and secretions removed in bathing. It is not known how soon or to what extent the evacuations of persons not suffering from contagious diseases become deleterious by their emanations; but the question hardly arises in hospital construction. To be on the safe side, it is necessary to provide for the prompt removal of this material, and to entirely prevent the emanations from reaching the wards. If the evacuations could be conveyed to a distance the instant they leave the body, in air-tight receptacles, by hand, so that they might never come in contact with any permanent part of the building, a great deal of complicated and expensive apparatus could be dispensed with, and an ideal condition of purity would be maintained. It is not probable that such a plan will ever be followed in any permanent hospital unless much more danger can be shown to attach to present methods than is at all probable. The expense and the difficulty of ensuring faithful service would doubtless be great. It is interesting, however, to note in this connection that, in the American ambulance established in Paris during the late war, the history of which was published by Dr. T. W. Evans at London in 1873, although there was a water-supply, and indeed a sink with an outlet into the street sewers, in each ward, where water soiled by washing the hands was allowed to be thrown, there were no water-closets. Dressings, and the water used in dressings, were burned in a deep trench at a distance. Textile fabrics not worth cleansing were buried. The excreta were all received in *fosses mobiles*—cylindrical zinc boxes holding twenty gallons each, provided with handles and with a funnel-shaped, wide-lipped basin—which were sunk in the ground to a proper depth, and were situated in cabinets or open closets at one side of the hospital grounds, ten to fifty yards from the various wards. There were also provided near by separate vessels of thirty gallons' capacity for receiving urine, which were rather more readily accessible, so that the liquid and solid excreta were separated to some extent. These were all treated occasionally with chlorinated lime or protosulphate of iron, and were removed and replaced by empty clean ones every forty-eight hours by the agents of a company engaged in the business. Clean gravel was sprinkled over the ground around them every few days to keep it dry and clean. The discharges of all patients who were unable to walk out in winter must have been carried from the various wards by the attendants. The system seems to have proved satisfactory.

Various methods have been suggested, and their excellence endorsed by high authority, for the reception of excreta in vessels containing ashes or dried earth, to be frequently removed and renewed. The earth-closet, designed by the Rev. Mr. Moule, is in quite common use in places where water-closets cannot be used, but has not replaced them elsewhere. The writer knows of no hospital where a dry system is in use, or where it is likely to be; yet it would be an instructive experiment to submit to the crucial test of practical experience some such plan, elaborated and modified to suit the circumstances, and carried out in the perfection of detail which only the discipline of a hospital would render possible. It is by no means certain that the weight of scientific authority may not at some future time, in the progress of knowledge, utterly condemn our present methods of underground sewerage. In that case such observations would acquire great value.

The earth-closet consists of a receptacle below for the sewage, a reservoir or hopper above, containing dried earth, and a "chucker," moved by means of a handle, after evacuation, which throws a sufficient quantity of earth over the excreta to cover and absorb them. The earth is required to be perfectly dried, either by artificial heat, or by sheltered exposure to air. The properties of such earth are quite remarkable; one and one-half pounds of it are sufficient to absorb and completely deodorize each evacuation; and it has the effect of very speedily disintegrating fecal matter, so that after a few days it can no longer be distinguished by sight or odor, and the earth can be re-dried and used repeatedly. Indeed, it s practically impossible to so impregnate he earth used in this way as to make it pay for its removal as a fertilizer. Dr. Richardson, in the Twelfth Annual Report of the Medical Officer of the Privy Council, in 1869, enumerates the advantages of this system, and states the imits of its application very widely. It would not be difficult to arrange a series f such closets, in connection with a hos-ital ward, which would be convenient of se and free from any danger of contami-ating the air. The disadvantages would e the labor and consequent expense of a arge supply of dry earth, which in a ospital should be of the best quality, and only used a second time after long xposure; and the constant labor of removing the contents of the closets at short ntervals. Ashes, from its tendency to se in a cloud, is not a suitable material. ood garden-loam or clay is the best. he closets should be so constructed as to reclude the possibility of the excreta uching any part of the receptacle, and he earth should be delivered from more han one point, so as to secure a thorough distribution. The receptacle below e seat should be made of cast iron, so that it could be purified at intervals by means of a gas-jet with a Bunsen burner, which could conveniently be attached to a bellows or elastic air-bulb, or to a copper receptacle for compressed air. This apparatus, connecting with the nearest gas fixture by a rubber tube, delivering with an easily regulated amount of force a smokeless jet of air and flame, is an efficient means of disinfecting any accessible cavity or surface which is not readily combustible, by devitalizing the organic dust which is constantly being deposited from the atmosphere.

The "Goux" system of collecting excreta in receptacles lined with dry absorbent material, with or without a disinfectant, is thus described in Bailey Denton's Sanitary Engineering. It is reported to be in successful operation in Halifax, Nova Scotia.

"A tapering tub or container is provided, say sixteen and one-half inches high, and twenty inches at its greatest diameter. Upon the bottom of the tub is placed three or four inches of refuse, such as new stable-litter, loft-sweepings, stack-bottoms, ferns, shavings, sawdust, shoddy, flax-dressings, spent tan, or hops, or the various waste materials to be found in the town or country; this is mixed with a little soot, charcoal, gypsum, or other deodorizer, for the purpose of packing or lining the tub. A mould of the same shape as the tub, but six inches less than the internal diameter, is placed upon the four inches of absorbent material referred to, and the space between the mould and the tub is packed with the same kind of refuse. One boy can pack eighty tubs in an hour, and this is all the manipulation required, excepting placing and removing the tubs at stated times. The absorbent material having been only moderately pressed down, the mould is withdrawn, and there remains a cavity into which the dejections fall, the liquid parts of which are taken up by the absorbents and retained by them, so as to check fermentation."

There would be little difficulty in adapting this system to hospital use. Coal ashes with the admixture of a little clay would be the most available material; and the auxiliary use of dried earth, so as to keep everything covered and deodorized, would be an improvement.

Authorities of the present day are nearly unanimously in favor of the removal of excreta by water carriage, on the ground of its cleanliness, convenience, economy, and speed. Provision has to be made, at any rate, for a large quantity of waste water from bath-tubs and sinks, containing considerable amounts of fermentable and objectionable material. This quantity is probably never less under any circumstances than ten gallons per day for each person; and where there is a free supply of water, and especially in a hospital, it reaches ten to twenty times that amount. The additional quantity which results from the use of water-closets is not a matter of much importance; in fact, its bulk may be of advantage in flushing the pipes; but the character of the material is very different. It would not be desirable under any circumstances for foul water, without excreta from water-closets, to remain very long within a hospital before removal. Yet, except in the case of bathing a patient with some exceptional contagious disorder, there would be no extreme haste; and the atmosphere of the hospital would not suffer from any emanations from it before the beginning of putrefaction. It could be readily disinfected if necessary, and its receptacles could be easily and thoroughly cleansed by ordinary means. Its removal in uncovered vessels would not be a source of offence; and if it were to be conveyed through a pipe to a distant point, as for example, for irrigating purposes, the apparatus could be reduced to the simplest terms, and could be made perfectly void of offence. If desired, a single pipe with a single inlet could be made to answer the purposes of an entire ward or building. Traps and ventilation could be dispensed with, or reduced to the extent of a simple flush-tank with an air-pipe opening into a chimney. Except when opened at stated times for the reception of slops, the single hopper-sink which would surmount the pipe could be cleansed and closely covered, and the system of drainage rendered theoretically as well as practically harmless, by the closure of a valve. The vessels in which the various slops were received, having no inaccessible outlet-pipes, could also be made theoretically safe and clean, which is impossible as they are now generally constructed. If we inspect and smell of the inside of that portion of the outlet of a bath, basin, or sink which lies between the plug and the trap below; and if we remember how constantly the volatile products of the putrefaction, which has become manifest to our senses, are disseminated through the air under the law of the diffusion of gases, and how these sources of corruption are to be found in an ordinary dwelling of modern construction, from cellar to attic, and especially often in the sleeping-rooms, we might be led to ask how it is, if a minute crack in a soil-pipe is to be regarded as the cause of the appearance of diphtheria or scarlatina in a building, that all inmates of all houses do not suffer in the same way? These outlets connect with the same system as the soil-pipes,—often with the soil-pipes themselves. It is known that gases which lie in contact with one surface of water in an ordinary trap will be absorbed and given off from the other surface. It is more than likely that organic germs could follow the same course; and if organisms which cause disease are propagated in the material which exists below the traps, they may surely also find a home in the similar material above. But if it be a fact that the gas of sewers, under ordinary circumstances, is less frequently dangerous than some writers would claim; it is also true that under other circumstances, which we are powerless to recognize or guard against, it is extremely dangerous, and may at any time be the vehicle of infectious disease. The deduction from the discovery of the foul condition of outlet-pipes is not that we should disregard the entrance of contaminated air into dwellings, but that a drained basin, tub, or sink, as ordinarily constructed, is not a safe neighbor, whether in dwelling-house or hospital; and that if it were not for the water-closets, the best plan would be to have in each hospital ward, or unit of construction, but a single sink and waste-pipe, as described; and the possibility of reaching such a simple and safe form, is an argument, as far as it goes, in favor of a dry system of removal.

Water-Closets.—The first consideration in hospital construction is, of course, *safety.* Unfortunately, in the past, the comforts and advantages of the best hospitals, in spite of skilled treatment and nursing, have sometimes been purchased too dearly, on account of danger to life and health from infectious diseases originating in the hospitals themselves. It would be very difficult to prove that disease in hospitals has ever originated in the water-closets, but it is conceded that it should be made impossible for them to contaminate the atmosphere of the wards. The details of their construction and situation have received much attention from writers, and they are not all in agreement on the subject. The best form of closet for a hospital ward is a "hopper," expanding into a "drip tray" at the top. This "drip tray" is a shallow sloping sink, the full size of the seat, about eighteen inches square. When the cover and seat are both raised, it is ready for use as a sink, or as a urinal, thus replacing the leaden casing formerly in use, which could not be kept clean, and was a source of offence. The drip tray is made of porcelain, in one piece with the bowl, and every part is accessible for cleansing, except such as are covered by running water while in use. This is the only form of fixed urinal which is desirable in a hospital or dwelling, for those of the usual pattern cannot be thoroughly cleaned, and are almost sure to exhale an unpleasant odor. The front edge of the drip tray should come forward flush with the wood-work in front, which should slope in a few inches at the bottom, to make room for the toes of the person standing before it. The bowl should have a "flushing rim" immediately below the drip tray, so that water may be delivered all around, and every part be constantly covered with flowing water while in use. Such bowls have only been obtainable within a few years, but are now made by Charles Harrison & Company, of New York. Besides the constant flow over the sides of the bowl, a cascade should flow into the bowl, after use, large enough to wash the discharge through the S trap below; and a chain hanging conveniently at the side of the seat is better than a handle to pull up, to start the flow. If the closets are to be used by ignorant or very dull persons, the opening of the door should also cause the flow. The under-surface of the seat of the loset should be about three-quarters of n inch higher than the surface of the rip tray, and the space between should ead behind to a ventilating shaft, in hich a constant current of air is main- ained by a gas jet or otherwise. If the as is used it can be utilized for lighting he closet at night by means of a trans- arent door. A window in the water loset can be used for occasionally flush- g the room with air, but there should e no other ventilator than that described. hus the air is continually moving towards e bowl, and as it passes laterally back- ard it arrests all odor where it origi- tes. Fresh air must be constantly sup- ied to the room by a special duct, and ould, of course, be warmed in winter. he fresh-air register may be placed in e lobby, just outside the door of the oset, and an opening left beneath the or, or through it. The general direc- n of the current of air will thus be ay from the ward and toward the soil pe. The cleansing of bed-pans can be re conveniently done in a sink or hop- r, specially constructed for the purpose, ge enough to admit the pan, with a se attached, and with a ventilating flue o. All the soil pipes should be made iron, and conducted to the roof in full e, where they should be freely open, t protected by a cowl from obstruction snow and rain. Below, the soil pipe ould be hung in plain view from the ling of the basement, and descending a proper grade, pass through the ndation into the ground at such a th as to be protected from frost. Be- e it enters the drain, it should be pped; and somewhere above the trap a ventilating pipe should enter it, which should be carried preferably near a chimney, so as to be warmed in severe weather, and seeking the roof should be cowled like the soil pipe. The free circulation of air throughout the entire length of the soil pipe is thus provided for.

The water-closets should be separated from the wards by a brick wall, which should surround them from the foundation; being thus practically as if contained in a turret, although enclosed within the general lines of the building. If leakage or accident occurs, the effect will be confined to the turret. A lobby can be interposed between the turret and the ward, with separate air supply and ventilation.

These precautions will have isolated the closets and their pipes from the general sewerage system; ventilated them independently in every part; and finally absolutely detached their atmosphere from that of the wards. The first requirement, of safety, has thus been fulfilled. Most of the late authorities, however, while insisting on these precautions, somewhat illogically place them at such a distance from the ward as to interfere seriously with their convenience and even usefulness. Dr. Wylie puts them in a separate building, separated from the ward by an open space of ten feet. Dr. Stephen Smith would place them in the basement story. It is very important that patients should attend to the calls of nature promptly, and that the use of the closets should begin as early in convalescence as possible. The use of bed-pans and urinals in a ward is of course necessary in many cases; but in practical administration it is the most flagrant source of discomfort that intrudes itself during the day's experience. After use, it is very undesirable that these utensils should be borne for a distance through the main entrance to the ward, appropriate for food, visitors and attendance generally. The closets should be immediately accessible from the ward, so that they can be sought without toilet preparation; and the entrance should be a separate one. If the precautions taken have not made them safe, they should be done away with; if they are safe, they should surely be placed as near as convenience demands.

The outlets to the various sinks, tubs, etc., adjacent to the wards, may be connected with the soil pipes; with the precaution that each should be trapped below, and that at each tub or basin the pipe should be ventilated by being continued up and opening freely at the roof. The ordinary use of these pipes, and of the soil-pipes, is such as to scour them sufficiently; so no provision is needed for flushing them otherwise.

SEWERS.—Below the trap which terminates the lower end of each soil-pipe, the outflow should be received by pipes or drains, forming an entirely separate system from all others,—the sewers proper. The essential requirements for a sewer are stated as follows by Col. Waring, the author of "Sanitary Drainage of Houses and Towns," published in 1878.

"1. It must be perfectly tight from one end to the other, so that all matters entering it shall be securely carried to its outlet; not a particle of impurity leaking through into the soil.

"2. It must have a continuous fall from the head to the outlet, in order that its contents may 'keep moving,' there being no halting to putrefy by the way, and no depositing of silt that would endanger the channel.

"3. It must be perfectly ventilated, so that the injurious gases that necessarily arise from the decomposition of matters carried along in the water, or adhering to the sides of the conduit, shall be diluted with fresh air, and shall have such means of escape as will prevent them from forcing their way into houses through the traps of house-drains.

"4. It must be provided with means for inspection, and, when necessary, for flushing.

"5. Its size and form must be so adjusted to its work or to its flushing appliances, that the usual flow may be made to keep it free from silt and organic deposits."

Impermeability is of special importance in the sewer of a hospital, as it is there, if anywhere, that the excreta, being those of diseased persons, might be expected to become a source of disease. It is to be secured by choice of material, and care in construction. As there is but little variation to be expected in the amount of flow, the circular form is the best, and at the present day earthen pipe can be procured of all sizes, and of great strength, up to 15 inches diameter. If this is used, it is often best to be bedded in concrete; and local moisture should be provided for, where necessary, by a small tile drain by its side. Ventilation should be secured by connecting the sewer with a permanently hot flue; either that of the steam boilers, which are generally required at a hospital, may be used; or, still better, a small furnace may be constructed for the special purpose, and the sewer gases rendered harmless by passing through it. Fresh air should be supplied to each branch of the sewer near its origin; but as the opening should not be so situated that any accidental back draught could contaminate the neighborhood of the wards, a small pipe may serve to conduct it from a suitable distance. Flushing might be secured by means of a "Field's tank" at each branch sewer; but a better plan would be to arrange for the simultaneous free discharge of fresh water, at intervals, from all parts of the hospital.

A plan for sewerage and subsoil drainage under very peculiar requirements is described by the trustees of the Johns Hopkins Hospital in a circular of the year 1877. The hospital lot is on a hillside, near its summit. The soil, for a depth of about sixty feet, is composed of alternate layers of sand and stiff clays, much folded and contorted, thus forming underground basins containing sand and water. Two springs and several marshy places existed on the grounds; and it was evident that the water which fell upon the hill above the lot came to these wet points through underlying sand layers and veins. These sand veins lay so deep on the higher ground that it was found impossible to reach them there, and thus cut off the supply. The city of Baltimore having no proper sewerage, the only point at which permission could be obtained to discharge drainage was into a public channel at a considerable distance. To this a large tile drain was laid, leading from a very large silt-trap constructed at the lowest corner of the grounds, which is about eighty feet above tide-water. A system of pipe-drains conveys the water of the greater part of the lot, including the surface water, to this silt-trap; but no sewerage proper from the water-closets, etc., is to enter it. At the higher part of the lot, however, a spring was found which could not be drained without work of great magnitude and expense. After some preliminary experiments, a well five feet in diameter was sunk about fifty feet from the spring, and at the depth of fifty-eight feet a bed of coarse gravel was struck. "Into this well the water from the spring was turned, as also some small veins of water opened in excavating in the vicinity. The result has been entirely satisfactory, the well rapidly conveying away the water turned into it. The greatest depth of water in this well, soon after a heavy rain, was eleven feet, and three days later this was reduced to five feet. This result is the more gratifying since it is certain that the bed of gravel into which this well drains underlies the whole of the hospital lot at a depth of from sixty to eighty feet; and we may therefore feel confident that by a system of such wells we can dispose of all the sewage of the hospital for many years to come, even if the city fails to provide the proper outlets, which can hardly be supposed possible. If care be taken to allow as little grease and fatty matters as possible to enter such a well, and to keep all rainfall out of it, as has been done by the system of drainage established, it will be a long time before it will fill up so as to become useless. Two old wells upon the grounds have also been used for the same purpose, and, although not now needed, may become useful in the future."

If the bed of gravel which is relied on for the disposal of the sewage proper, in this novel system, were near the surface, there would be little question of its condemnation by sanitarians. It may be doubted whether even at this considerable depth it is too far off to exert influence on health in any way, or whether careful ventilation of the wells, which certainly would be required, would render them perfectly safe. If sickness should prevail, as it is apt to do at times, both in and out of hospitals, they will probably always be objects of solicitude and distrust. The difficulties in the way of an unobjectionable system of water-carriage in this peculiar case are so great, that the trial of an improved dry-earth method for the excreta would seem particularly desirable.

FORM AND MATERIAL OF HOSPITALS.

The advantages of lateral expansion in hospital construction were pointed out as arly as the year 1786 by a Committee of he French Academy of Sciences; and nasmuch as the weight of authority since hat time has steadily increased in its avor, it might be supposed that the quesion of the best general form would be ettled. In fact, very few would now eny that *other things being equal*, a one tory pavilion plan should be preferred; nd that it would be an advantage to have o enclosed connection between the differnt parts of the hospital, if the climate ere such as to make this practicable. his is the case in the City Hospital of erlin, built in 1870. There are some vo-story pavilions, and some of one ory; but they are widely detached, and ave no connecting corridors—only gravel alks between. In the Johns Hopkins ospital, the basements of pavilions are be connected, but considerable variice of opinion is found to exist as to hat is justifiable and wise where cirumstances prevent lateral expansion. 1877 the trustees of the New York ospital completed a building of seven ories and a basement, intended for the eatment of acute diseases and injuries, the midst of the city. No expense as spared in its construction, and the hitect announced the fundamental prinle that æsthetical considerations of oportion and architectural effect, must entirely subordinated to the needs of the patients in comfort, light and ventilation. The authorities of the institution claimed that a hospital in that situation was necessary, and that lateral expansion was impossible. They believed that mortality in pavilion hospitals in civil life had not proved materially less than the average elsewhere. They instanced the Royal Infirmary of Edinburgh, the Amsterdam Hospital, St. Thomas's Hospital, the new wing of the London Hospital, and the new Hôtel-Dieu of Paris, as showing that the necessity for more or less compactly constructed hospitals in central positions, is recognized in the great cities abroad. They regarded it as a common error to trust too much to construction, and to undervalue the importance of other sources of safety. In other words, they hoped to counterbalance the disadvantages of their general plan by excellence of details and of administration. Dr. Van Buren, in his address at the inauguration of the new building, said:—

"In the matter of hospital hygiene, as in hospital construction, science has not as yet spoken her last word. Since the Federal Government adopted the plan of pavilion hospitals at the suggestion of the Sanitary Commission, the application of a new discovery in physical science to the wants of practical surgery has rendered us, in a certain degree, independent of hospital construction. It has been shown how we can keep wounds sweet and healthy, and conduct them to a favorable ending by a shorter and surer route than that heretofore followed, and thus prevent hospital patients from poisoning each other. Pasteur's demonstration that putrefaction is a fermentative process, that certain organic particles floating in the air as dust, constitute the ferment or yeast, and that the destruction or exclusion of these germs will infallibly prevent septic change in substances prone to take on putrefaction, promises to alter many of the present methods of practical surgery. By preventing putrefaction in recent wounds, we cut off the most fertile surgical source of hospitalism. In addition to the means furnished by judicious hospital construction to secure uncontaminated air by forced ventilation, we shall therefore be able, hereafter, we are told, to keep the air of a hospital pure (surgically) by eradicating the source. This has, apparently, been demonstrated to be practically feasible by the use of agents capable of destroying the vital energy of putrefactive germs." He also recounted that Prof. Lister, during a visit to America, in reply to a question suggested by the four stories of superposed wards of the Charity Hospital at Blackwell's Island, said, "It is immaterial how many stories of wards there may be in a hospital, provided that the details of the antiseptic method are accurately carried out in all of them. If these details are faithfully observed, hospitalism can be prevented."

Those who consider some sort of pavilion plan the only justifiable method of construction, are by no means agreed as to whether they should consist of one or of two stories. Two of the essays contributed for Johns Hopkins Hospital, decidedly recommend two stories, and three recommend the one story plan. Both forms are to be used in that institution. The Cook County Hospital, in Chicago, Illinois, erected in 1876, has four stories, three of which are occupied by wards. Dr. Billings states that the air in the *lower* wards is purer than in those above. The arguments for one-story wards are strongly presented by Dr. George Derby, in an article which forms part of the Fifth Annual Report of the State Board of Health of Massachusetts, for 1874. Perfection of isolation and of ventilation are obviously the strongest reasons in their favor. But in practical experience, the convenience of having a hospital all on one level, with inclined planes, if necessary, where slight changes of elevation occur, is also worth consideration. By means of trucks with rubber tires, one attendant can silently perform the work which would require two in a building where staircases abound. Dr. Wylie, in the essay already quoted, sums up his views as follows:—

"1. Experience and science agree in showing that widely detached one-story wards allow the most thorough ventilation, and therefore the smallest chance for the accumulation of infectious particles.

"2. They neutralize the evils of massing large numbers of cases — or, what amounts to the same thing, varieties of cases, under one roof. They make classification of cases easy and natural.

"3. They require less vigilance; dust and foul air find fewer lurking-holes and channels; cleanliness and ease of supervision, as well as fresh air, are more readily secured. Two-story hospitals may be kept healthy for a few years with extreme care and intelligence. Hospitals of more than two stories ought never to be contemplated.

"4. The detached-ward plan, which is hygienically the safest, is also the most economical, apart from the amount of land required. A ward hopelessly poisoned by long occupation, if detached, can be torn down without disturbing the general order; and when additional accommodation is necessary, other wards may be added one by one, or a short ward can be extended.

"5. An immense advantage of one-story wards . . . is the ease with which patients can be taken, bed and all, out of doors in fine weather. Even the very feeble can be wrapped in a blanket and rolled out on the grass by an incline, with no fatigue of 'getting ready.'"

The argument for two-story wards is based on economy of construction and administration, and on the comparative purity of the upper strata of the atmosphere. The economy is denied by Dr. Wylie, above; the argument as to purity is an over-refinement. Both arguments might readily be also applied to prove the superiority of three stories over two, and so on.

The question of material is directly associated with that of form. The healthfulness of tents and barracks demonstrated in army experience, has led some writers to contend for destructible buildings. Dr. Billings wrote, in 1870, that no hospital should be constructed with a view to its being used as such for more than fifteen years; but in 1875, he says, "I am satisfied that the statement that this temporary character should be adopted for all hospitals, and especially for all parts of hospitals, was too sweeping. That is to say, I do not think it necessary, that all the buildings of an hospital should be destroyed or removed at certain regular intervals, in order to prevent infection; and there are some things to be taken into account in favor of more permanent structures, under certain circumstances to which I did not give sufficient consideration.

"Barrack hospitals are best suited for government purposes," etc. . . . "It is an error to suppose that a barrack hospital will prevent hospitalism. . . . I have seen a decided tendency to erysipelas and pyemia appear in a most characteristic barrack ward, an unplastered building, with excessive ridge-ventilation, within six weeks after it was first occupied. . . . All the arguments in favor of a barrack hospital apply with still greater force to one composed mainly of tents. . . . I am of opinion that all the good qualities of a barrack or tent hospital can be combined with those of a permanent structure in such a manner as to secure both the healthfulness of the one, and, to a considerable extent, the convenient and economical administration of the other."

In this country, brick, or the combination of brick and stone, is the material generally to be preferred, and should be painted externally, to promote dryness. Architectural effects should depend, in all buildings occupied by patients, on variation in color, rather than irregularity of contour, so that nothing may interfere with the free sweep of the air about the building.

If it be granted that wards for ordinary medical and surgical cases are better to be permanent structures, it must still be acknowledged that cheap and destructible buildings are better for infectious and contagious diseases, and for cases of exceptionally offensive character. Every large general hospital needs isolating wards, so called. In some climates, and at some seasons, tents, properly framed and floored, leave nothing to be desired. They can be set up almost at a moment's notice, and dismantled and disinfected as promptly. In extremes of weather, however, it is difficult to warm and ventilate them with absolute perfection. There would be some advantages in the use of wooden pavilions of the general type adopted for the army hospitals of the United States. But they are neither one thing nor the other. Their cost would be so considerable that they would not be destroyed very frequently; and if a building is safely occupied for months or years, it becomes difficult to determine when to abandon it. It would probably be less expensive and equally safe to build of brick; and to so arrange that the interior could easily be dismantled and entirely renewed. If a considerable number of separate rooms were provided in such a permanent structure as this, where cases could be treated which did not need the most rigid kind of isolation, a comparatively small number of absolutely separate buildings would suffice. The present writer has elsewhere suggested, for this special purpose, the use of sectional buildings made of pine wood, the different parts of which fasten together by hooks and bolts, so that one can be erected in an hour without the aid of a carpenter. Such a building might be eight by seven feet, and seven feet high at the eaves, with a door in one end and a winlow opposite. The floor should be raised a foot above the ground. A frame with lats resting on cleats would supply the place of a bedstead, and a bedtick filled with hay would be used instead of a hair mattress. In one corner would be a hole hrough the roof, protected by soapstone, or the funnel of a small stove, and beneath the stove a cold-air register. It hould have electric or telephonic connecions with the nearest ward; and could hus be set up so far away as to preclude ll idea of infection. Being constructed n the lightest possible way, its stability ould be maintained like that of a tent, y guys of rope or wire. In very cold ituations it could be provided with panels, which would give an air-space in the reater portion of the walls, or the space ould be filled with saw-dust or tan. A ent-fly would protect it in hot or wet weather. After use the building could be taken apart, exposed to the sun and air for a sufficient time, or disinfected by some more rapid process. It could then receive a thin coat of varnish or paint, and be stowed away for future use. Such an inexpensive structure could be destroyed and renewed at brief intervals without much more cost than the interest on a proportionate integral part of a permanent building.

Shape of Wards.—Most of the later writers on the subject advocate the elongated, rectangular shape, with the long axis running from north to south. All interference with the influence of the direct rays of the sun is to be deprecated; and for this reason the access to the ward, the service-rooms and so forth, are placed at the north; and a "sun-room," glazed on all sides, is attached to the southern wall of the ward. In constructing some pavilion wards at the Massachusetts General Hospital in the year 1873, the trustees adopted the form of a square of about 45 feet, for twenty beds, at the suggestion of the present writer; and it was recommended at a later time, enlarged to about 56 by 43 feet, for twenty-three beds, after practical experience, for the Johns Hopkins Hospital, where it has been partially adopted for two pavilions of two stories each, with the corners cut off, making the shape octagonal, and with other deviations from the plans of the writer. The square form of room with a central large chimney stack was originally suggested by Mr. G. M. Dexter, one of the trustees of the Massachusetts General Hospital, in 1844; and its excellence for the wards of a hospital built on the "block" plan, has been long acknowledged. The principal advantages over the long shape, for a pavilion, are the privacy of each bed, as compared with its situation in a long hall without obstruction to the view; the absence of draughts, the fire-places and warm air supply in the central stack being nearly equally distant from all parts of the ward, and the chimney-stack, by its volume and position, interrupting and mixing accidental air-currents; and the ease of administration; the beds being nearly equi-distant from the supplementary rooms of the ward.

Mr. Niernsée, the architect of the Johns Hopkins Hospital, in an appendix to the volume of essays, gives sketches for large octagonal wards, with equal sides, one form being designed for twenty-four, the other for thirty-nine beds.

Dr. Wylie, in criticizing the square ward, remarks: "In the long ward there is more wall-space, and therefore the beds are not so near each other, as in a square ward of the same capacity; and if the square ward exceeds 30 feet, there is a greater volume of air to be moved between opposite windows, the sunlight does not so completely reach all parts of the ward, and the surface of the ground beneath is further removed from the purifying influences of light. In the square ward the patients are nearer the service-rooms, but at the same time they are more in danger of infection from that source. The ward recommended by Dr. Wylie is '30 feet wide, 15 feet to the roof at the eaves (the roof having a slant of not less than 30 degrees), and long enough to give for the medical ward 9 feet of wall-space to each bed, for the surgical ward not less than 10 feet, and 16 feet for the ward for dangerous cases.'"

The recommendations as to shape, of most writers, are more or less influenced by the relations of the windows to ventilation; but as a fact, in most climates and at most seasons, dependence must be placed on artificial ventilation for a thorough supply of fresh, warm air without draughts, and if the apparatus is efficient, the windows may be disregarded. The desirability of square wards, as suggested by the writer, depends partly on the completeness and excellence of the system of heating and ventilating attached to it, and as it is believed to exemplify the requirements recognized at the present day, some of its features will be described.

The sick require that a nearly uniform temperature should be maintained in all weathers; and their supply of fresh air should be equally uniform. The air needs to be artificially heated for a considerable part of the year throughout the temperate zone. It is obvious that artificial propulsion of the air is necessary at all times, except when the windows are freely open; and sometimes, even when the external temperature would admit of opening them, the air is so stagnant that it is better to resort to artificial means. The necessity for warming the air should of course be taken advantage of, when possible, for its propulsion; that is, the course of the ducts should conform to the natural tendency of hot air to rise. The use of a fan, with an extensive system of distributing-ducts, is strongly recommended by Dr. Billings; and the elaborate and interesting observations made at the Barnes Hospital in Washington go far to justify it. The indications for its adoption depend in considerable measure on the size and character of the hospital. Where a moderate supply of air is sufficient, and if the climate is such as to require considerable artificial heat, it is less needed. For such a class of cases as would be placed in an isolating ward, it would be an unquestionable advantage to have such a propelling force as a fan in reserve, and also for the purpose of flooding or "blowing out" ordinary wards, which it is advantageous to do at intervals, though it cannot be considered an absolute necessity if the regular air-supply is sufficient. The fan is also valuable as a means of cooling and refreshment in hot weather. Dr. Huntington, of the Barnes Hospital, states that, although it is not continuously used in that institution, being reserved for warm stagnant mornings and evenings, to create a draught throughout the building, to "blow out" and assist other apparatus in cooler weather, and for cooling accidentally overheated rooms, still, "taking into consideration its efficacy in moving and changing air, and the comfort to patients both summer and winter, it is certainly a cheap luxury." Cheapness is of course a relative term. A fan is to be used as an auxiliary in the ventilation of the common and isolating wards of the Johns Hopkins Hospital. The original cost of the fan, a fifteen horse-power steam engine, and the necessary ducts, will be sixteen thousand dollars, a small item in an institution of such magnitude as this. Fresh air can of course only be had by paying for it, unless the climate admits of living out-doors. But in deciding the fan question in a given case, it should first be ascertained whether, by a proper arrangement of ducts, the heat necessary for comfort cannot be made to move the air properly during very nearly the whole of the time. If this is the case, the additional force required in an emergency can be supplied at slight expense without machinery. One element in the problem of air-supply is the cubic space allowed to each bed. The smaller the space, the more rapidly the air will be changed with a given force, and, equally, the smaller will be the amount of force required for a sufficient supply. There is a limit, however, to the rapidity with which fresh air can be safely introduced, on account of the speedy chilling of the surface of the body when blown on by a current of air. In other words, a draught should be avoided. On the other hand, supposing that some limit must be placed upon the air-supply, there is a positive disadvantage in too large an air space, and especially in too great height of a ward, as it is difficult to secure a proper uniform dilution or distribution of the air. The limits in both directions, and as to the floor-space desirable for each bed in a ward, are pretty well settled, and need not be further discussed here.

As in the ventilation of water-closets, so in the ward, there is a decided advantage in removing the vitiated air at a point as near the source of vitiation as possible. An opening for a duct in the floor is objectionable on account of its becoming a receptacle for dust and dirt. In the writer's plan for a square ward, the foul-air ducts arise from grated openings, without valves, in the side-walls near the beds, and descending to the level of the basement floor, seek the central chimney. This chimney has on opposite sides two open Franklin stoves, with cast iron flues, which pass up through the chimney cap. These open fires, for constant use in all weather cool enough to call for any artificial heat, remove a considerable amount of air from the middle of the room, while the radiant heat from them and their cheerful aspect render them a practical source of great comfort. The iron flues, by steady radiation, warm the air in the main shaft of the chimney sufficiently to give a downward draught through all the twelve foul-air ducts at once in all weathers. In weather too warm for any fire, if the free opening of windows and the use of a modification of ridge-ventilation in the roof are not sufficient, a small fire is kindled in a basket grate in the bottom of the chimney, accessible from the basement. The upper two feet of the windows have transom sashes, hung on hinges at the bottom, opening inward; there are openings in the main shaft of the chimney near the ceiling, and two large openings in the ceiling, controlled by valves and cords; the latter openings lead to a ridge-space around the chimney, with louvers at the end also controllable. In mild weather, and at times when the air of the ward is particularly offensive, these openings will give it free and rapid exit from the upper part of the room. Fresh air is supplied to the ward by ducts, which run from openings on the east and west sides to enclosed stacks of radiators at the corners of the chimney, in the basement, the design being to take advantage of the direction of the wind in securing a free influx of air by closing the openings to leeward. These external openings of the fresh-air ducts can safely be carried up a few feet from the ground, so as to secure a purer atmosphere; but one advantage of a fan which has not yet been mentioned would be the feasibility of drawing the fresh air supply from a much greater height. The radiators, which supply auxiliary heat in weather cold enough to demand it, should contain either hot water or steam at a low pressure. In a mild and equable climate water answers every purpose, and is preferred by most authorities. In a severely cold climate with sudden changes, steam is much better, on account of the promptness with which it responds to an increase of the heating power. The fresh-air duct, at the point where it reaches the radiators, has a mixing-valve, which, set at one limit, directs the air wholly upon and among the radiators, after which it rises to the ward, thoroughly heated, through large drums or registers situated on the sides of the chimney alternate to the stoves; set at the other limit, the valve sends the air over the top of the radiators, very slightly warmed, up to the ward; and it can be so adjusted at intermediate positions as to temper the flow as desired. The fresh-air ducts pass immediately beneath the Franklin stoves, and a register under each is to be opened when the steam radiators are not in use, so that the entering current, which should be constant in all weathers, comes directly in contact with the stoves, which are made double to allow the air to pass up between the layers of soapstone, and be heated.

Thus, in weather requiring the great body of the air-supply to be artificially warmed, the windows and top ventilators would be closed most of the time, and the general course of the air would be as follows: A large volume of very slightly heated air would enter the middle of the room, and, rising by virtue of its less specific gravity to the upper part of the room, would be diffused equally, and, cooling somewhat, descend at the walls. The central fireplaces would draw a certain amount of the lower strata of air in their direction, but the greater portion would leave the ward by the peripheral vertical openings which are beneath the patients' beds. Thus the emanations from patients will be, to a great extent, drawn from the ward at once, by a short path, instead of becoming diffused.

In many climates the excessive dryness of the air, in seasons when artificial heat is in use, results in a feeling of chilliness that a high temperature does not relieve. Both health and comfort are promoted by adding artificial moisture to the air. The use of steam from the radiators would obviously be a convenient means of doing this, but it is apt to leave a slightly disagreeable odor. Porous vessels of water may be hung in the hot-air ducts with advantage. Dr. Billings proposes "to place a ring of water-pipe in the main air duct, near the fan, perforated in such a way that a sheet of spray can be produced for washing, moistening, and slightly cooling the air. To make this available in cold weather, for adding a small percentage of moisture to the air, the air must be warmed a little before passing it through the spray, and this can perhaps best be effected by placing a coil in the supply-duct of the fan, which coil could be supplied by the exhaust-steam from the engine."

DISINFECTION.

The importance is recognized by all late writers, of providing for the destruction of all infected material about a hospital, or for its thorough disinfection.

Provision is necessary for the free exposure of bedding and clothing to sunlight and air, after being used a certain time, and in case of any doubt as to the existence of contagious disease, the exposure of all organic material which is preserved to a temperature above that of boiling water in metallic chambers is advised.

Some writers have advised the occasional disinfection of the buildings themselves, by constantly letting a certain proportion of the wards remain empty or "fallow" for the purpose.

TRAINING-SCHOOLS FOR NURSES.

Great success has attended the efforts which have been made to improve the character of private nursing in English and American cities, by means of training-schools established at various hospitals, both public and private. In most instances they were permitted to assume the charge of the nursing with great solicitude on the part of the hospital authorities, lest the interests of the patients should suffer from too great a preponderance of unskilled persons among the nurses, and lest the high wages obtainable by thoroughly trained nurses should draw off the best material among the pupils before their obligations to the hospitals were fulfilled. It has fortunately proved to be the fact that wherever they have been judiciously managed, the training-schools have improved the character of the nursing, or thoroughly maintained the standard of excellence, and in some instances have gained hearty approval and cordial aid and instruction from attending medical officers, who tacitly or actively disapproved the innovation. This chapter of hospital and sanitary reform, in this country at least, has acquired an importance that is as unexpected to many medical men as it is gratifying. It may finally be considered as proved not merely that systematic instruction of hospital nurses is worth while, but that a succession of carefully trained nurses can be supplied to the community without any one's suffering harm by the process.

ADMINISTRATION OF HOSPITALS.

The day has gone by when a hospital could be managed like a hotel, or, we might say, in view of the proneness of boards of government to select superannuated sea-captains as superintendents, like a ship at sea.

The rapid advances of science, and the demand for the immediate utilization of results, necessitate that the governing officer of a hospital should be an accomplished physician. Hospital management and construction together, have almost become a profession, or rather a special branch of medicine. It is true that some large institutions still have lay superintendents, but the voices of those best qualified to judge are practically unanimous in favor of a permanent resident medical chief. Dr. Billings has well defined the most important of his duties in calling him the Health Officer of the hospital. By the use of the most improved instruments of precision, automatic means of registration, and judicious experimentation in methods of construction and management of details, a properly qualified officer may make what was formerly a pursuit of routine and stagnation, a progressive and fascinating study, and obtain results of the greatest value to society.]

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